UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southwest Region
501 West Ocean Boulevard, Suite 4200
Long Beach, California 90802-4213

MAY 18 2001

In Reply Refer to:
SWR-01-SA-5667:BFO

Mr. Chester V. Bowling
Operations Manager
United States Bureau of Reclamation
Central Valley Operations Office
3310 El Camino Ave., Suite 300
Sacramento, California 95821

Dear Mr. Bowling:

This letter transmits the National Marine Fisheries Service (NMFS) biological opinion on interim operations of the Central Valley Project (CVP) and State Water Project (SWP) between January 1, 2001, and March 31, 2002, on federally listed threatened Central Valley spring-run chinook salmon and threatened Central Valley steelhead in accordance with section 7 of the Endangered Species Act of 1973 (ESA), as amended (16 U.S.C. 1531 et seq.). Your letter dated December 18, 2000, initiated formal consultation, subsequently your letter dated January 6, 2001, requested NMFS to extend consultation through March 2002.

This biological opinion is based on information referenced in, and provided with, your December 18, 2000, January 6, 2001, and February 23, 2001 letters including: 1) Biological Assessment and appendices A through I, dated November 2000; 2) document entitled Fall/Winter Juvenile Salmon Decision Process (October 1 through January 31, 2001; 3) Supplemental Information including forecasts for 2001 operations and water temperatures. A complete administrative record of this consultation is on file at NMFS Sacramento Area Office, Sacramento, California.

Based upon the best available scientific and commercial information, the enclosed biological opinion concludes that the interim operations of the CVP and SWP facilities between January 1, 2001, and March 31, 2001, are not likely to jeopardize the continued existence of federally threatened Central Valley spring-run chinook salmon and threatened Central Valley steelhead or result in the destruction or adverse modification of designated critical habitat for these species.

As provided in 50 CFR § 402.16, reinitiation of formal consultation is required if: (1) the amount or extent of taking specified in the incidental take statement is exceeded; (2) new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered in this opinion; (3) the action is subsequently modified in a way that causes an effect on listed species or critical habitat not considered in this opinion; or (4) a new species is listed or critical habitat is designated that may be affected by the action.

If you have any questions concerning the enclosed biological opinion please contact Mr. Bruce Oppenheim in our Sacramento Area Office, 650 Capitol Mall, Suite 8-300, Sacramento, CA 95814. Mr. Oppenheim may be reached by telephone at (916) 930-3603 or by FAX at 916-930-3629.

Sincerely,

Rodney R McInnis

for Rebecca Lent, Ph.D.
Regional Administrator

Enclosure

cc:

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Endangered Species Act-Section 7 Consultation

BIOLOGICAL OPINION

Agency: U.S. Bureau of Reclamation, Mid-Pacific Region, Sacramento, California

Activity: Central Valley Project (CVP) and State Water Project (SWP) Operations, January 1, 2001 through March 31, 2002

Consultation Conducted By: National Marine Fisheries Service, Southwest Region.

Date Issued: MAY 8 2001

I. INTRODUCTION

This document transmits the National Marine Fisheries Service (NMFS) biological opinion on Central Valley Project (CVP) and State Water Project (SWP) Operations through March 31, 2002 on federally listed threatened Central Valley spring-run chinook salmon (*Oncorhynchus tshawytscha*), and threatened Central Valley steelhead (*O. mykiss*) in accordance with section 7 of the Endangered Species Act of 1973 (ESA), as amended (16 U.S.C. 1531 et seq.).

This biological opinion is based on our review of information referenced in and provided with letters, dated December 18, 2000, January 6, 2001 and February 23, 2001, from the Bureau of Reclamation (Reclamation) initiating formal consultation on the effects of the Central Valley Project (CVP) and State Water Project (SWP) Operations through March 31, 2002, including: 1) a Biological Assessment addressing the proposed action; 2) a draft Juvenile Chinook Salmon Protection Decision Process, dated 11/14/00; 3) the January 2001 50 percent and 90 percent exceedence (with Shasta Criteria) operations forecasts; 4) a series of temperature studies for the American River; and, 5) forecast temperatures in the Stanislaus and Sacramento River under 50 and 90 percent exceedance conditions.

Consultation History

On March 27, 2000, the National Marine Fisheries Service (NMFS) issued a biological opinion to the U.S. Bureau of Reclamation (Reclamation) and the California Department of Water Resources (DWR) that assessed the effects of the operation of the Central Valley Project (CVP) and State Water Project (SWP) during the period between December 1999, and March 2000, on Federally threatened Central Valley steelhead and threatened Central Valley spring-run chinook salmon. Based on the best available scientific information, this biological opinion concluded that the operation of the CVP and SWP between December 1999, and March 2000, was not likely to jeopardize the continued existence of Central Valley spring-run chinook or Central Valley steelhead, or result in the destruction or adverse modification of proposed critical habitat for these species. However, some incidental take of steelhead and spring-run chinook salmon was anticipated and authorized take levels for each species was specified in an incidental take statement attached to the March 27, 2000, biological opinion.

Since the issuance of the March 27, 2000, biological opinion, the NMFS has worked with Reclamation and DWR through the CALFED Operations Group and the Central Valley Project Improvement Act (b)(2) Interagency Team to minimize impacts associated with CVP/SWP operations and ensure that incidental take does not exceed specified levels.

On August 28, 2000, the CALFED Bay-Delta Program issued a Record of Decision (ROD) that lays out a 30-year program for increasing water supply reliability to California water users and restoring the Central Valley ecosystem. Recognizing that implementation of the CALFED Program will result in changes to CVP/SWP operations over the 30-year life of the program, NMFS, Reclamation and DWR agreed that a long-term CVP-OCAP consultation should be conducted after the CALFED ROD was released. However, considerable modeling and other analysis relative to CVP/SWP operations and the CALFED Program must be completed to initiate this consultation for long-term operations. Therefore, NMFS, Reclamation, and DWR agreed to conduct annual consultations for CVP and SWP operations based on the most current water supply and operations forecasts until a long-term CVP-OCAP consultation for Central Valley spring-run chinook and Central Valley steelhead can be completed.

Reclamation's facilities to be addressed in this interim consultation include all CVP units, except the Friant Division and Lewiston Dam of the Trinity River Division. DWR's facilities to be addressed in this interim consultation include the following: Oroville-Thermalito Complex, Harvey O. Banks Delta Pumping Plant, Clifton Court Forebay, Skinner Fish Protective Facility, Northbay Aqueduct, and the Suisun Marsh Salinity Control Structure. Facilities and operations of CVP and SWP contractors are not addressed in this consultation and, thus, are not provided authorization for incidental take through this consultation.

Regularly scheduled meetings between NMFS, DFG, DWR, and Reclamation were initiated in July 2000. Results of monitoring, stranding, and redd studies for Clear Creek, Stanislaus and Feather River were presented by DFG and DWR at a meeting in September 2000. Results from American River monitoring were obtained from unpublished data (Snider, per. com. 2000). Target dates for the interim biological opinion were announced at the January 2001 meeting.

By letter dated December 13, 2001, to the NMFS, Reclamation initiated formal consultation for the period of April 2000, through March 2001, and provided a biological assessment dated November 2000. An initial project description was included in the biological assessment along with the most recent revision of the Fall/Winter Juvenile Salmon Decision Process for October 1 through January 31, 2001 (formerly the Spring-Run Protection Plan).

On January 6, 2001, Reclamation requested NMFS to extend consultation through March 2002 and based their current assessment of potential impacts from CVP/SWP operations on the

January 2001, 50 and 90 percent exceedance forecast (with Shasta Criteria). Dry hydrologic conditions have persisted to date during water year 2001, and Reclamation's 90 percent exceedance forecast projects dry or critically dry conditions for 2001.

By letter dated February 23, 2001, to the NMFS, Reclamation provided additional supplemental information with revised operations forecasts and temperature studies for the Feather River to update the project description presented in the December 13, 2000 letter. Reclamation requested that NMFS base the assessment of potential effects to Central Valley spring-run chinook salmon and Central Valley steelhead on the 50 and 90 percent exceedance forecast dated February 15, 2001.

The first meeting for a long-term CVP-OCAP consultation was held on February 23, 2001, between NMFS, CDFG, FWS, DWR, and Reclamation to construct a framework to proceed. The agencies recognized that the first step in this process would be to acquire additional biological information as identified in this consultation.

II. DESCRIPTION OF PROPOSED ACTION

A. Description of CVP/SWP Facilities

1. Description of Central Valley Project Facilities Upstream of the Delta

General descriptions of the CVP and associated facilities are discussed in this section and are provided for background information only. Specific operations of the CVP and SWP are described in the section entitled "*Description of the Proposed Operations of the Central Valley Project Facilities from January 1, 2001 through March 31, 2002*".

(a) Trinity River Division

The Trinity River Division, completed in 1964, includes facilities to store and regulate water in the Trinity River, as well as facilities to divert water to the Sacramento River Basin. The main facilities of the division include the Trinity Dam and Powerplant; Trinity Reservoir (2,448,000 AF capacity); Lewiston Dam, Lake, and Powerplant; Clear Creek Tunnel; Judge Francis Carr Powerhouse; Whiskeytown Dam and Lake (241,000 AF capacity); Spring Creek Tunnel and Powerplant; and Spring Creek Debris Dam and Reservoir (5,800 AF capacity).

Trinity Reservoir releases are re-regulated downstream at Lewiston Dam and Lake to meet downstream flow, in-basin diversion, and downstream temperature requirements. Lewiston Lake also provides a forebay for the trans-basin diversion of flows through the Clear Creek Tunnel and the Judge Francis Carr Powerhouse into Whiskeytown Lake on Clear Creek.

Water stored in Whiskeytown Lake includes exports from the Trinity River as well as runoff from the Clear Creek drainage. A majority of the water released from Whiskeytown Lake travels through the Spring Creek Tunnel and Powerplant and is discharged into Keswick Reservoir on the Sacramento River. A small amount of water from the lake is also released through the Whiskeytown Dam outlet works and the City of Redding Powerplant into Clear Creek which flows into the Sacramento River below Keswick Dam.

The Spring Creek Debris Dam is also a feature of the Trinity River Division of the CVP. It was constructed in 1963 to regulate runoff containing acid mine drainage from Iron Mountain Mine in the Spring Creek watershed. The Spring Creek Debris Dam can store up to approximately 5,800 AF of water. Runoff containing acid mine drainage from several inactive copper mines and exposed ore bodies at Iron Mountain Mine is stored in Spring Creek Reservoir. Since 1990 concentrations of toxic metals in acidic drainage from Iron Mountain Mine has progressively decreased due to several remedial actions including the construction and operation of a lime neutralization plant. Operation of the Spring Creek Debris Dam and Shasta Dam has allowed some control of the toxic wastes with dilution criteria.

(b) Sacramento River Division

The Sacramento River Division of the CVP includes facilities for the diversion and conveyance of water to CVP contractors on the west side of the Sacramento River. At Red Bluff, the Sacramento Canals Unit of the Sacramento River Division includes the Red Bluff Diversion Dam, the Corning Pumping Plant, and the Coming and Tehama-Colusa canals. These facilities provide for diversion and conveyance of irrigation water to over 200,000 acres of land in the Sacramento Valley, principally in Tehama, Glenn, Colusa, and Yolo counties. The Sacramento River Division also includes Black Butte Dam and Lake. Black Butte Dam and Lake were integrated into the CVP in 1970. The facilities are operated jointly by the Army Corps of Engineers and Reclamation to provide for flood control and for irrigation water supplies, respectively. Black Butte Reservoir provides supplemental water to the Tehama-Colusa Canal as it crosses Stony Creek.

(c) Shasta Division

The Shasta Division of the CVP includes facilities that conserve water on the Sacramento River for flood control, navigation maintenance, conservation of fish in the Sacramento River, protection of the Sacramento-San Joaquin Delta from intrusion of saline ocean water, agricultural water supplies, municipal and industrial (M&I) water supplies, and hydroelectric generation. The Shasta Division includes Shasta Dam, Lake, and Powerplant; Keswick Dam, Reservoir, and Powerplant; and the Toyon Pipeline. Shasta Dam and Lake (4,552,000 AF capacity) is the largest storage reservoir on the Sacramento River. Completed in 1945, Shasta Dam controls floodwater and stores winter runoff for various uses in the Sacramento and San Joaquin valleys. Keswick Dam, located approximately 9 miles downstream from Shasta Dam creates an afterbay (23,000 AF capacity) for Shasta Lake and Trinity River diversions. Keswick Dam and Reservoir stabilizes the peak hydroelectric operation water releases from Spring Creek and Shasta Powerplants. Anadromous fish trapping facilities at Keswick Dam are operated in conjunction with the FWS. Some of the salmon trapped at the Keswick fish trap are taken for use as broodstock at the Coleman National Fish Hatchery approximately 25 miles downstream of Keswick Dam on Battle Creek, tributary to the Sacramento River.

Construction of a temperature control device (TCD) at Shasta Dam was completed in 1997. This device is designed to selectively withdraw water from elevations with Shasta Lake while enabling hydroelectric power generation. The TCD allows greater flexibility in the management of cold water reserves in Shasta Lake for maintenance of adequate water temperatures in the Sacramento River downstream of Keswick Dam.

Approximately 5 miles downstream of Keswick Dam, the Anderson-Cottonwood Irrigation District (ACID) has been diverting water for irrigation from the Sacramento River since 1916. The ACID diversion dam and canal operate seasonally from the spring through fall of each year to deliver irrigation water supplies along the westside of the Sacramento River between Redding and Cottonwood. A contractual agreement between the Federal Government and ACID provides for diversion of water and requires Reclamation to reduce Keswick Dam releases to accommodate the installation, removal, or adjustment of boards associated with the ACID diversion dam.

(d) American River Division

The American River Division includes the Folsom Unit, Sly Park Unit, and Auburn-Folsom South Unit of the CVP. These facilities conserve water on the American River for flood control, fish and wildlife protection, recreation, protection of the Sacramento-San Joaquin Delta from intrusion of saline ocean water, agricultural water supplies, municipal and industrial (M&I) water supplies, and hydroelectric generation. The Folsom Unit consists of Folsom Dam and Lake (977,000 AF capacity), Folsom Powerhouse, Nimbus Dam, Lake Natoma, and Nimbus Powerplant on the American River. The Sly Park Unit which provides water from the Consumnes River to El Dorado Irrigation District (EID) includes Jenkinson Lake formed by Sly Park Dam on Sly Park Creek, a low concrete diversion dam on Camp Creek, and Sly Park Conduit. The Folsom and Sly Park Units were added to the CVP in 1949. In 1965, the Auburn-Folsom South Unit was authorized and includes County Line Dam, Pumping Plant, and Reservoir; Sugar Pine Dam and Reservoir; Linden and Morman Island Pumping Plants; Folsom South Canal; and other necessary diversion works, conduits, and appurtenant works for delivery of water supplies to Placer, El Dorado, Sacramento, and San Joaquin counties.

Although Folsom Lake is the main storage and flood control reservoir on the American River, numerous other small reservoirs in the upper basin provide generation and water supply. None of the upstream reservoirs have specific flood control responsibilities. The total upstream storage above Folsom lake is approximately 820,000 AF. Ninety percent of this upstream storage is contained by five reservoirs: French Meadows; Hell Hole (208,000 af); Loon Lake (76,000 af);

Union Valley (271,000 af) and Ice House (46,000 af). French Meadows and Hell Hole reservoirs, located on the Middle Fork of the American River are owned and operated by Placer County Water Agency. (PCWA). PCWA provides wholesale water to agricultural and urban areas within Placer County. Loon Lake on the Middle Fork, and Union Valley and Ice House reservoirs on the South Fork of the American River are operated by Sacramento Municipal Utilities District (SMUD).

(e) Eastside Division

The New Melones Unit of the Eastside Division includes facilities that conserve water on the Stanislaus River for flood control, fish and wildlife protection, bay-delta flow requirements, dissolved oxygen requirements, Vernalis water quality, agricultural water supplies, municipal and industrial (M&I) water supplies, and hydroelectric generation. Facilities consists of New Melones Dam, Reservoir (2.4 million AF), and Powerplant. Other water storage facilities in the Stanislaus River include the Tri-Dam project, a hydroelectic generation project that consists of Donnells and Beardsley dams located upstream of New Melones on the middle fork Stanislaus River, and Tulloch Dam and Powerplant, located approximately six miles below New Melones Dam on the mainstem Stanislaus River. Releases from Donnells and Beardsley dams affect inflows to New Melones Reservoir. Under contractual agreements between Reclamation and the Oakdale Irrigation District (OID) and South San Joaquin Irrigation District (SSJID), Tulloch Reservoir provides afterbay storage to re-regulate power releases from New Melones Powerplant. Approximately 1.9 miles downstream of Tulloch Dam is Goodwin Dam and Reservoir. Goodwin Dam, constructed by OID and SSJID in 1912, creates a re-regulating reservoir for releases from Tulloch Powerplant. Goodwin Reservoir is the main water diversion point for the Stanislaus River and includes diversions through two canals running north and south of the Stanislaus River for delivery to OID and SSJID. Water impounded behind Goodwin Dam may also be pumped into the Goodwin Tunnel for deliveries to the Central San Joaquin Water Conservation District and the Stockton East Water District. Goodwin Reservoir also provides releases to the lower mainstem Stanislaus River.

2. Description of State Water Project Facilities Upstream of the Sacramento/San Joaquin Delta

General descriptions of the SWP and associated facilities are discussed in this section and are provided for background information only. Specific operations of the SWP are described in the section entitled "*Description of the Proposed Operations of the Central Valley Project Facilities from January 1, 2001 through March 31, 2002*".

(a) Oroville-Thermalito Complex

The Oroville-Thermalito Complex of the SWP includes facilities that conserve water on the Feather River for power generation, flood control, recreation, and fish and wildlife protection. The Oroville-Thermalito Complex includes the following: Oroville Dam and Lake (3,538,000 AF capacity), and Edward-Hyatt Powerplant; Thermalito Diversion Dam, Power Canal, Diversion Pool, Diversion Dam Powerplant, Forebay and Afterbay; and Fish Barrier Dam (see Figure 4 in BA). A maximum of 17,000 cfs can be released from Oroville Dam through the Edward Hyatt Powerplant. Approximately four miles downstream from the Oroville Dam/Edward-Hyatt Powerplant is the Thermalito Diversion Dam. The Thermalito Diversion Dam creates the Thermalito Diversion Pool which acts as a water diversion point and includes diversions to the Thermalito Power Canal on the north side (majority of the flow; up to 17,000 cfs) and to the Feather River on the south side. This river section on the south side between the Thermalito Diversion Dam and the Thermalito Afterbay outlet is commonly referred to as the low flow channel. Flows are typically a constant 600 cfs through this 8-mile low flow channel except during periods when flood control releases from Oroville Lake are in effect. The Fish Barrier Dam at the upstream end of the low flow channel is an impassable barrier that diverts water for use by the DFG's Feather River Fish Hatchery.

The Thermalito Power Canal hydraulically links the Thermalito Diversion Pool to the Thermalito Forebay (11,768 AF capacity; offstream regulating reservoir for the Thermalito Powerplant); water diverted at the Thermalito Diversion Dam travels through the Thermalito Power Canal and empties into the Thermalito Forebay. Water from the Thermalito Forebay exits through the Thermalito Powerplant into the Thermalito Afterbay and is either used by diverters directly from the Afterbay or is released back into the Feather River approximately 8 miles downstream of its original diversion point. Thermalito Afterbay provides for local diversions that can take up to 4,050 cfs during peak demands. In addition, excess water conserved in storage within the Thermalito Afterbay can be used for pumpback operations through both the Thermalito and Edward-Hyatt Powerplants when economically feasible. The Thermalito Diversion Pool serves as a forebay when the Edward-Hyatt Powerplant is pumping water back into Lake Oroville.

3. Description of Central Valley Project and State Water Project Facilities within the Sacramento/San Joaquin Delta

General descriptions of the CVP and SWP's Delta facilities are discussed in this section and are provided for background information only. Specific operations of the CVP and SWP are described in the section entitled "*Description of the Proposed Operations of the Central Valley Project Facilities from January 1, 2001 through March 31, 2002.*"

The CVP and SWP use the Sacramento and San Joaquin Rivers and channels in the Delta to transport natural river flows and reservoir storage to two large water export facilities in the south Delta. The CVP's Tracy Pumping Plant and the SWP's Harvey O. Banks Delta Pumping Plant (Banks Pumping Plant) are operated to meet the water supply needs in the San Joaquin Valley, southern California, central coast, and south San Francisco Bay area.

(a) CVP Export Facilities and Associated Tracy Fish Collection Facility

The Tracy Pumping Plant, about five miles north of Tracy, California, consists of six pumps including one rated at 800 cfs, two at 850 cfs, and three at 950 cfs. Although the total plant capacity is about 5,300 cfs, the maximum permitted pumping capacity by the State Water Resources Control Board (SWRCB) is 4,600 cfs. The Tracy pumping plant is located at the end of an earth-lined intake channel about 2.5 miles long and pumps water from Old River into the Delta-Mendota Canal. A portion of the water conveyed through the Delta-Mendota Canal flows into the O'Neill Forebay and is lifted to the joint CVP/SWP San Luis Reservoir for storage.

At the head of the intake channel, the Tracy Fish Collection Facility is designed to intercept fish before they pass through the canal to the Tracy Pumping Plant. Fish are collected and transported by tanker truck to release sites away from the pumps. This facility uses behavioral barriers consisting of primary and secondary louvers to guide targeted fish into holding tanks. When compatible with export operations, the louvers are operated with the objective of achieving water approach velocities for striped bass of approximately one foot per second from May 15 through October 31 and for salmon of approximately three feet per second from November 1 through May 14. Channel velocity criteria are a function of bypass ratios through the facility. Hauling trucks are used to transport salvaged fish to release sites in the western Delta. The CVP maintains two permanent release sites: one on the Sacramento River near Horseshoe bend and the other on the San Joaquin River immediately upstream of Antioch Bridge.

(b) SWP Export Facilities, Clifton Court Forebay. and Associated Skinner Fish Protection *__Facility__*

The Banks Pumping Plant, about eight miles northwest of Tracy, California in the south Delta, consists of 11 pumps, including two rated at 375 cfs, five at 1,130 cfs, and four at 1,067 cfs. Water is pumped from the Clifton Court Forebay (CCF) through the Banks Pumping Plant into the California Aqueduct which has a nominal capacity of 10,300 cfs. Average daily pumping at the Banks Pumping Plant is constrained by diversion limitations at CCF. Water in the California Aqueduct flows to O'Neill Forebay, from which a portion of the flow is lifted to the joint CVP/SWP San Luis Reservoir for storage. From O'Neill Forebay, the joint-use portion of the aqueduct, San Luis Canal, extends south to the southern end of the San Joaquin Valley. The SWP portion of the aqueduct continues over the Tehachapi Mountains to the South Coast Region.

The CCF is a regulated reservoir at the head of the California Aqueduct in the south Delta. Delta water inflows to the Forebay are controlled by radial gates, which are generally operated during the tidal cycle to reduce approach velocities, prevent scour in adjacent channels, and minimize water level fluctuation in the south Delta by taking water in through the gates at times other than low tide. When a large head differential exists between the outside and inside of the gates, theoretical inflow can be as high as 15,000 cfs for a short period of time. However, existing operating procedures identify a maximum design rate of 12,000 cfs which prevents water velocities from exceeding three feet per second to control erosion and prevent damage to the facility.

In front of the Banks Pumping Plant, the Skinner Fish Protection Facility (SFPF) intercepts fish which are collected and transported by tanker truck to release sites away from the pumps. This facility uses behavioral barriers consisting of primary and secondary louvers to guide targeted fish into holding tanks for subsequent transport by truck to release sites within the Delta. When compatible with export operations, the louvers are operated with the objective of achieving water approach velocities for striped bass of approximately 1 foot per second from May 15 through October 31 and for salmon of approximately three feet per second from November 1 through May 14. Channel velocity criteria are a function of bypass ratios through the facility. Hauling trucks are used to transport salvaged fish to release sites. The SWP maintains two permanent release sites: one at Horseshoe bend on the Sacramento River and the other on Sherman Island at Curtis Landing on the San Joaquin River.

(c) North Bay Aqueduct Intake at Barker Slough

The SWP uses the North Bay Aqueduct intake at Barker Slough to divert water from the north Delta near Cache Slough for agricultural and municipal uses in Napa and Solano counties. Maximum pumping capacity is about 175 cfs. Daily pumping rates typically range from 20 to 130 cfs. The intake has apositive barrier fish screen consisting of a series of flat, stainless steel, wedge-wire panels with a slot width of 3/32 inch. The facility is operated to maintain a screen approach velocity of no greater than 2 feet per second.

(d) Delta Cross Channel

The Delta Cross Channel (DCC) is a controlled diversion channel located in the northern Delta between the Sacramento River and Snodgrass Slough, a tributary of the Mokelumne River. Reclamation operates the DCC to improve the transfer of water from the Sacramento River to the southern delta and export facilities at the Banks and Tracy pumping plants. To reduce scour in the channels on the downstream side of the DCC gate and to reduce potential flood flows that might occur from diverting water from the Sacramento River into the Mokelumne River system, the gates are closed whenever flows in the Sacramento River at Freeport reach 25,000 to 30,000 cfs on a sustained basis. Flows through the gates are determined by Sacramento River stage and are not affected by export rates in the south Delta. Pursuant to the WR Opinion and the SWRCB Water Quality Control Plan, the DCC gates are generally closed from February 1 through May 20 for the protection of emigrating juvenile salmon.

(e) Suisun Marsh Salinity Control Gates

The Suisun Marsh Salinity Control Gates (SMSCG) are located about 2 miles northwest of the eastern end of Montezuma Slough, near Collinsville. The SMSCG which span the entire 465 foot width of Montezuma Slough include permanent barriers adjacent to the levee on each side of the channel, flashboards, radial gates, and a boat lock. The structure is typically operated from September through May to tidally pump lower salinity water from Collinsville through Montezuma Slough into the eastern and central portion of Suisun Marsh. The SMSCG also serve to retard the movement of higher salinity water from Grizzly Bay into the western marsh. During full gate operation, the SMSCG open and close twice each tidal day. During ebb tides, the gates are open to allow the normal flow of lower salinity water from the Sacramento River to enter Montezuma Slough. During flood tides, the gates are closed to retard the upstream movement of higher salinity water from Grizzly Bay.

(f) Rock Slough

The Contra Costa Canal was built by Reclamation in 1948 and is currently operated by the Contra Costa Water District (CCWD). The Canal uses an unscreened intake facility at Rock Slough about four miles southeast of Oakley to divert water from the Delta for agricultural, municipal and industrial uses in central and northeastern Contra Costa County. The Rock Slough intake consists of four pumping plants that lift diverted water 127 feet into the Contra Costa Canal. This 47.7 mile long canal terminates into Martinez Reservoir. In addition, two short canals called Clayton and Ygnacio are integrated into the distribution system. Rock Slough has a diversion capacity of 350 cfs which gradually decreases to 22 cfs at the terminus.

Prior to 1997, Rock Slough was CCWD's primary diversion facility in the Delta and pumping ranged from 50 to 250 cfs with seasonal variation. In 1997, CCWD began additional diversions from the Delta at a new 250 cfs screened intake structure on Old River which is part of the recently completed Los Vaqueros Project. The Old River facility allows CCWD to directly divert up to 250 cfs of CVP water into an intertie with the existing Contra Costa Canal which allows for reduced diversion needs at Rock Slough. In addition, the Old River facility can divert up to 200 cfs of CVP and Los Vaqueros water rights for storage into the new 100,000 AF Los Vaqueros Reservoir.

Pursuant to the 1993 FWS delta smelt biological opinion for Los Vaqueros (Los Vaqueros Opinion), the Old River facility is now the primary diversion point for CCWD during January through August of each year. Additionally, according to the Los Vaqueros opinion and WR Opinion, CCWD is required to cease all diversions from the Delta for 30 days during the spring if stored water is available for use in Los Vaqueros above emergency storage levels. These operations criteria are designed to provide protection to Delta fisheries.

B. Description of the Operation Agreements, Constraints, and Objectives of the CVP and SWP

General operations of the CVP and SWP are discussed in this section and are provided for background information only. Specific operations of the CVP and SWP are described in the section entitled *"Description of the Proposed Operations of the Central Valley Project Facilities from January 1, 2001 through March 31, 2002."*

1. Trinity River and Clear Creek Instream Flow Requirements

Water Right permits issued by the SWRCB for diversions from Trinity River and Clear Creek specify minimum downstream releases from Lewiston and Whiskeytown dams, respectively. Historically, approximately two thirds of the annual Trinity River inflow of 1.2 million AF was diverted to the Sacramento Basin. Based on a May 8, 1991, decision by the Secretary of the Interior, 340,000 AF is allocated annually for Trinity River instream flows. The amounts and timing of Trinity River exports to the Sacramento Basin are determined after consideration is given to forecasted water supply conditions and Trinity River in-basin needs, including carryover storage. Also, temperature control operations on the Sacramento River for winter-run chinook influence the timing of Trinity diversions and to some extent the total amount of diversion.

In October 2000, the final Environmental Impact Statement/Report for the Trinity River Mainstem Fishery Restoration (FEIS/EIR) was released. The FEIS/EIR selected a new instream flow schedule for the Trinity River combined with additional watershed protection efforts. The Trinity River Mainstem Fishery Restoration preferred alternative was the subject of a separate section 7 consultation between NMFS and Reclamation and FWS. Formal consultation for the Trinity River Mainstem Fishery Restoration plan was concluded with the issuance of biological opinion by the NMFS on October 12, 2000. The biological opinion concluded that the implementation of the preferred alternative is not likely to jeopardize the continued existence of Southern Oregon/Northern California Coast coho salmon, Sacramento River Winter-run chinook salmon, Central Valley Spring-run chinook salmon, or Central Valley steelhead, or result in the destruction or adverse modification of designated critical habitat for these species.

Two agreements govern releases from Whiskeytown Lake to Clear Creek: a 1960, Memorandum of Agreement (MOA) with DFG, and the October 6, 1999, Final Decision. The 1960 MOA with DFG established minimum flows to be released into Clear Creek from Whiskeytown Dam. Subsequently, in 1963 a release schedule from Whiskeytown Dam was developed and implemented, but was never finalized. The October 6, 1999, Final Decision allows for establishment of the target flow's described in the November 20, 1997, Interior Final Administrative Proposal on the Management of section 3406(b)(2) Water (AFRP Plan). The AFRP Plan identifies minimum flows for Clear Creek below Whiskeytown based upon thresholds of Trinity Reservoir storage. Target flows range from 100 to 200 cfs from October through May and from 100 to 150 cfs from June through September.

2. Spring Creek Debris Dam

In January 1980, Reclamation, DFG, and the SWRCB executed a Memorandum of Understanding (MOU) to implement actions to protect the Sacramento River system from heavy metal pollution from Spring Creek and adjacent watersheds. The MOU identifies agency actions and responsibilities. It established release criteria based on allowable concentrations of total copper and zinc in the Sacramento River below Keswick Dam. When Spring Creek Reservoir storage exceeds 5,000 AF, the MOU provides for "emergency" relaxation amounting to a 50%

increase in the objective concentrations of copper and zinc. In recent years, Reclamation and DFG have agreed not to use the emergency criteria unless a spill occurs. The MOU also specifies a minimum schedule for monitoring copper and zinc concentrations at Spring Creek Debris Dam and in the Sacramento River below Keswick Dam. Reclamation has primary responsibility for the monitoring, although the DFG and Regional Water Quality Control Board (RWQCB) also collect and analyze samples on an as needed basis. The MOU states that the Reclamation agrees to operate according to these criteria and schedules provided that such operation will not cause flood control parameters on the Sacramento River to be exceeded or interfere unreasonably with other project requirements as determined by the Reclamation.

3. Upper Sacramento River Temperature Control

Elevated water temperatures in the upper Sacramento River have been recognized as a key factor in the decreasing populations of salmonid stocks that inhabit the river. Temperature on the Sacramento River system is influenced by several factors, including the relative temperatures and ratios of releases from Shasta Dam and from the Spring Creek Powerplant. The temperature of water released from these facilities is a function of the total storage at Shasta and Trinity lakes; depths from which releases are made; the percent of total releases from each depth; ambient air temperatures and other climatic conditions; tributary accretions and temperatures; and residence time in Keswick, Whiskeytown, and Lewiston reservoirs and in the Sacramento and Trinity rivers.

Reclamation operates the Shasta, Sacramento River, and Trinity River divisions of the CVP to meet, to the extent possible, the provisions of SWRCB Order 90-05 and the NMFS' (1993, as amended) WR Opinion. In 1990 and 1991, the SWRCB issued Water Rights Orders 90-05 and 91-01 modifying Reclamation's water rights for the Sacramento River. These SWRCB orders include temperature objectives for the Sacramento River including a daily average water temperature of 56°F at Red Bluff Diversion Dam (RBDD) during periods when higher temperatures would be harmful to the fishery. Under the orders, the compliance point may be changed when the objective can not be met at RBDD. In addition, Order 90-05 modified the minimum flow requirements in the Sacramento River below Keswick Dam initially established in the Reclamation and DFG (1960) MOA.

Pursuant to SWRCB Order 90-05 and 91-01, Reclamation devised and currently implements the Sacramento-Trinity Water Quality Monitoring Network. This network is used to monitor temperatures and other parameters at key locations in the Sacramento and Trinity rivers. Also as a result of the SWRCB orders, the Upper Sacramento River Temperature Task Group was developed by Reclamation to formulate, monitor, and coordinate temperature control plans for the upper Sacramento and Trinity rivers. This group consists of representatives from Reclamation, SWRCB, NMFS, FWS, DFG, Western Area Power Administration, DWR, and the Hoopa Valley Indian Tribe. Each year, with a finite amount of cold water resources and competing demands for water, the Temperature Task Group is charged with devising temperature control plans that provide the best protection for salmon consistent with the CVP's temperature control capabilities, considering the needs of winter-run chinook, spring-run chinook, and fall-run chinook salmon.

4. Sacramento River Instream Flow Requirements

Minimum flow requirements established by the NMFS' WR Opinion are more conservative than most of the minimum flow requirements of WR 90-05. The reasonable and prudent alternative (RPA) contained in the WR Opinion requires a minimum flow of 3,250 cfs from October 1 through March 31 for all water year types. Also, as part of the RPA, ramping constraints for Keswick Dam release reductions from July 1 through March 31 were required as follows:

a. Releases must be reduced between sunset and sunrise.
b. When Keswick release is 6,000 cfs or greater, decreases may not exceed 15% per night. Decreases also, may not exceed 2.5% in one hour.
c. For Keswick release between 4,000 to 5,999 cfs, decrease may not exceed 200 cfs per night. Decreases may also not exceed 100 cfs per hour.
d. For Keswick releases between 3,999 and 3,250 cfs, decreases may not exceed 100 cfs per night.

Reclamation typically attempts to reduce releases from Shasta and Keswick dams to the minimum fishery release requirements by October 15 each year and to minimize changes in releases from Keswick Dam between October 15 to December 31. Releases may be increased during this period to meet unexpected downstream needs such as higher outflows at the Delta to meet water quality requirements or to meet flood control requirements. Releases from Keswick Dam may be reduced when downstream tributary inflows increase to a level that will meet downstream flow needs. To minimize release fluctuations, the base flow is selected with the intent of maintaining the desired target storage levels in Shasta Lake from October through December.

In addition to the NMFS' WR Opinion, the October 6, 1999, Final Decision allows for the establishment of minimum flows below Keswick Dam to assist meeting the objectives of the CVPIA AFRP. Minimum flow requirements below Keswick Dam for October through April are based on thresholds of Shasta Reservoir storage. Stability criteria dictate that November, December, February, March, and April flows be at least 90% of the preceding month's flow. The stability criteria also dictates that January's flow be at least 80% of December's Keswick flow. The stability criteria may be ignored if the preceding month's flow is above 6,000 cfs. From May through August, minimum flow remains at 3,250 cfs, although releases for temperature control will usually exceed this amount.

5. Sacramento River Recreation

Although not an authorized purpose, recreational use of Shasta Lake is significant with the prime recreation season extending from Memorial Day through Labor Day. The Reclamation attempts to have Shasta Lake full by Memorial Day and at an elevation of no less than 1,017 feet on Labor Day. This elevation corresponds to a drawdown of 50 feet below the top of the conservation pool and is just below the bottom of the flood control storage envelope. Storage typically peaks in May and significant drawdown usually does not begin until July and August. The drawdown rate varies but is typically the highest during July and August in response to irrigation demands and temperature control operations. Customary patterns of storage and release usually result in acceptable water levels during the prime recreational season. During drought periods, recreation opportunities at Shasta Lake are reduced because of hydrology and the drawdown required to meet CVP uses.

6. Sacramento River Flood Control

Flood control objectives for Shasta Lake require that releases are restricted to quantities that will not cause downstream flows or stages to exceed specified levels. These include a flow of 79,000 cfs at the tailwater of Keswick Dam and a stage of 39.2 feet in the Sacramento River at Bend Bridge gauging station, which corresponds to a flow of approximately 100,000 cfs. Flood control operations are based on regulating criteria developed by the US Army Corps of Engineers pursuant to the provisions of the Flood Control Act of 1944. Maximum flood space reservation is 1.3 million AF with variable storage space requirements based on an inflow parameter.

The flood control criteria for Shasta specify that releases should not be increased more than 15,000 cfs or decreased more than 4,000 cfs in any one hour period. In rare instances, the rate of decrease may have to be accelerated to avoid exceeding critical flood stages downstream.

7. Anderson-Cottonwood Irrigation District Diversion Dam

A contractual agreement between the Federal government and ACID provides for diversion of water and requires Reclamation to reduce Keswick Dam releases to accommodate the installation, removal, or adjustment of boards associated with the ACID diversion dam. Around April 1 of each year, ACID erects the diversion dam by raising the steel superstructure, installing the walkway, and then setting the boards in place. Placing the support beams generally requires flows in the Sacramento River to be reduced to less than 6,000 cfs. Wood and fiberglass stop logs are hand-placed across the pier to create a backwater pool for diversion into the ACID canal. Removing or adding boards in the dam generally requires flows of 10,000 cfs or less. The boards are taken out of the dam every year in mid-November. During the irrigation season, adjustment of the boards may be necessary due to changes in releases at Keswick Dam (FWS and ACID 1999).

8. Navigation Requirements and Related Issues at Wilkins Slough

As an authorized function of Shasta and Keswick dams, the Reclamation is obligated by the River and Harbors Act of 1937 and subsequent acts to operate Shasta Dam to improve navigation. Rivers and Harbors Committee Document Number 35, 73rd Congress recommended providing channel depths of 5 to 6 feet and 5,000 cfs minimum flow between Sacramento and Chico Landing. However, in 1952, a decision was made not to allocate storage space in Shasta Lake for navigation. In recent years, there has not been any commercial traffic between Sacramento and Chico Landing. Thus, the Corps has not maintained (dredged) this reach to preserve channel depths since 1972. While navigation for commercial vessels is no longer a concern on the lower Sacramento River, the 5,000 cfs minimum flow recommendation has served as the basis for the design of many irrigation pumping stations in the vicinity of Wilkins Slough, a reach of the Sacramento River immediately upstream of the confluence with the Feather River. To minimize the impact on these divertors, Shasta and Keswick dams are normally operated to provide a minimum flow of 5,000 cfs at Wilkins Slough in all but extremely dry years.

9. Red Bluff Diversion Dam

The Red Bluff Diversion Dam is currently operated according to the NMFS WR Opinion's RPA element 6 that specifies the Red Bluff gates will be raised from September 15 through May 14, with a provision for consideration of requests for closure of the gates for up to ten days, once per year, for critical diversion needs.

10. Feather River Instream Flow and Temperature Requirements

The August 1983 agreement between DWR and DFG "Concerning the Operation of the Oroville Division of the State Water Project for Management of Fish & Wildlife" sets criteria and objectives for flow and temperatures in the low flow channel and the reach of the Feather River between Thermalito Afterbay and Verona. This agreement establishes (1) minimum flows between Thermalito Afterbay Outlet and Verona which vary by water year type, (2) requires flow changes under 2,500 cfs to be reduce by no more than 200 cfs during any 24-hour period, except for flood control, failures, etc., (3) requires flow stability during the peak of the fall-run chinook spawning season, and (4) sets an objective of suitable temperature conditions during the fall months for salmon and during the late spring/summer for shad and striped bass.

11. Feather River Flood Control

Flood control requirements and regulating criteria for Oroville Reservoir are specified by the Corps flood control diagram (Corps 1971). From June 15 through September 15, no flood control restrictions exist. Full flood reservation space is required from November 17 through February 7. From September 16 through November 16 and from April 20 through May 31, reserved storage space for flood control is a function of the date. Beginning February 8 and continuing through April 20, flood reservation space is a function of both date and wetness.

12. American River Instream Flow Requirements

Prior to the CVPIA, the American River Division facilities were operated to help maintain natural fish production in the American River below Nimbus Dam by maintaining minimum fishery flows established in D-893 and proposed in D-1400 while also attempting to meet temperature objectives. The historical operation practice is termed a Modified D-1400 operation because it incorporates minimum flow objectives similar to D-1400 when hydrologic conditions are supportive and limits releases to D-893 minimum fish flow objectives only under very adverse hydrologic conditions. Therefore, minimum flows can range from 250 cfs in months with very low Folsom Reservoir storage to 3,000 cfs in months with high storage and hydrologic projections of ample runoff. D-893 allows for flows less than 250 cfs if water supply deficiencies are placed on CVP water users.

The October 6, 1999, Final Decision allows for the establishment of minimum flow recommendations below Nimbus Darn to assist meeting the fisheries objectives of the CVPIA. Minimum flow recommendations below Nimbus Dam from October through December are based on thresholds of Folsom Lake end-of-year September storage. Minimum flow recommendations from January through September are based on thresholds of Folsom Lake previous month storage plus inflow.

Regarding seasonal fluctuations and ramping of streamflows in the lower American River, Reclamation proposes to use draft criteria established by members of the American River Operations Group (see American River temperature control section below). This ramping criteria is presented in Table 1.

Table 1. Ramping criteria proposed for the Lower American River.

During any 24 hour period do not decrease Nimbus flows (measured in cfs) more than the ranges shown in column 1	Do not make individual Nimbus release decreases (measured in cfs) greater than values in column 2
Column 1	Column 2
20,000 to 16,000	1,000 - 1,500
16,000 to 13,000	1,000
13,000 to 11,000	500-800
11,000 to 9,500	500
9,500 to 8,000	500
8,000 to 7,000	300-350
7,000 to 6,000	300-350

6,000 to 5,500	250
5,500 to 5,000	250
Below 5,000 up to 500/24 hr.	50/hour

13. American River Temperature Control

Elevated water temperatures in the lower American River have been recognized as a key factor in the decreasing populations of salmonid stocks that inhabit the river. Temperatures on the American River are influenced by several factors, including the relative temperatures and volume of releases from the limited capacity of the coldwater pool reserve within Folsom Lake. The temperature of water released from Folsom Dam is a function of the following: total storage in Lake Folsom; depths from which releases are made; the percent of total releases from each depth; ambient air temperatures and other climatic conditions; tributary accretions and temperatures; and residence time in Folsom Lake and Lake Natoma.

The Reclamation operates the American River Division of the CVP to meet, to the extent possible, the temperature objectives for the Nimbus Fish Hatchery and the American River Trout Hatchery, while maintaining suitable temperatures for instream salmonids. The interagency American River Operations Group (Reclamation, FWS, NMFS, DFG, Sacramento County, and Save the American River Association) was created in 1996 and assists Reclamation adaptively manage releases and water temperature conditions on the lower American River to meet the needs of fall-run chinook salmon and steelhead within the river.

14. American River Flood Control

Flood control requirements and regulating criteria are specified by the Corps for the American River (Corps 1987). From June 1 through September 30, no flood control restrictions exist. Full flood reservation space is required from November 17 through February 7. From October 1 through November 16 and from April 21 through May 31, reserved storage space for flood control is a function of the date. Beginning February 8 and continuing through April 20, flood reservation space is a function of both date and wetness.

Since 1996, Reclamation has operated to modified flood control criteria which reserves 400 to 670 TAF of flood control space in Folsom Reservoir and a combination of upstream reservoirs. This flood control plan, which provides additional flood protection for the Lower American River, is implemented through an agreement between Reclamation and the Sacramento Area Flood Control Agency (SAFCA). The terms of the agreement allow some of the empty reservoir space in Hell Hole, Union Valley, and French Meadows to be treated as if it were available in Folsom. Although some of the SAFCA release criteria differ from the Corps plan, the criteria generally provide greater flood protection than existing Corps criteria for Folsom. Required flood control space may begin to decrease on March 1. Between March 1 and April 20, the rate of filling is a function of available upstream space. As of April 21, the required flood reservation is about 175 TAF. From April 21 to June 1, the required flood reservation is a function of the date only with Folsom storage allowed to completely fill on June 1.

15. Stanislaus River flow requirements

The operating criteria for New Melones Reservoir are governed by water rights, instream fish and wildlife requirements, Bay-Delta flow requirements, dissolved oxygen requirements, Vernalis water quality, and CVP contracts. Reclamation's obligation to meet downstream water rights was originally defined in a 1972 Agreement and Stipulation among the Reclamation, OID and SSJID. This agreement was superceded by a 1988 Agreement and Stipulation that requires Reclamation to release New Melones Reservoir inflows of up to 600,000 AF each year for diversion of water at Goodwin Dam by OID and SSJID in recognition of their water rights. In years when inflows to New Melones Reservoir are less than 600,000 AF per year, Reclamation provides all inflows plus one third the difference between the inflow for that year and 600,000 AF. This agreement also created a conservation account in which the difference between entitled quantity and the actual quantity diverted by OID and SSJID in a year may be stored in New Melones Reservoir for use in subsequent years. In addition, water is released from New Melones Reservoir to satisfy riparian water rights downstream of Goodwin Dam that total approximately 48,000 AF per year.

CVP operations on the Stanislaus River through water year 1999 are derived from a Two-Year Interim Stanislaus Agreement, known as the New Melones Interim Plan of Operations (NMIPO). The NMIPO defines categories of water supply based upon New Melones end-of-February storage plus forecasted March to September inflow. It then allocates water release for fishery, Bay-Delta criteria, water quality, and use by CVP contractors.

Until the Interior completes the development of long-term criteria, AFRP flow targets on the Stanislaus River are based on the water supply established by the NMIPO. After the water supply is calculated using the end-of-February storage plus forecasted March to September inflow, the total volume of water for fishery purposes is determined for the water year. Once the yearly volume is established, the distribution of flow volumes within the year are based on Reclamation and FWS coordination and consultation with DFG. This minimum annual volume allocated for fishery purposes (98,000 AF) is consistent with D-1422 requirements which require up to 98,000 AF of water per year be provided from New Melones Reservoir to the Stanislaus River on a distribution pattern to be specified each year by DFG for fish and wildlife purposes. However, under existing operations, the NMIPO may not always provide 98,000 AF for fish in all years.

Conductivity standards were originally established in *D-1422* which specified that New Melones Reservoir be operated to maintain an average monthly level of conductivity, measured as total dissolved solids (TDS), of 500 parts per million (ppm) TDS for all months on the San Joaquin River at Vernalis. However, as part of WR 98-9, the operational water quality objectives at Vernalis were modified to include separate objectives for the irrigation and non-irrigation season according to the 1995 WQCP. The revised standards are average monthly concentrations of 0.7 mS/cm conductivity (approximately 455 ppm TDS) from April through August and 1 mS/cm (approximately 650 ppm TDS) from September through March.

Water service contracts held by Reclamation for the delivery of water from New Melones were based on a 1980 hydrologic evaluation of the long-term availability of water in the Stanislaus River basin. Based on this evaluation, Reclamation entered into a long-term service contract for up to 49,000 AF per year of water annually (based on a firm water supply) and two long-term service contracts totaling 106,00 AF per year (based on an interim water supply).

In addition to the above criteria, Reclamation and DWR signed (1998) a statement of support and committed to pursue the implementation of the San Joaquin River Agreement (SJRA) through the SWRCB, along with other agencies comprising the San Joaquin Tributary Association. The SJRA includes a 12-year experimental program providing flows and exports in the lower San Joaquin River during a 31-day pulse flow period in April-May. It also provides for the collection of experimental data during the pulse flow period to further understand the effects of flows, exports, and the Head of Old River Barrier on salmon survival. This experimental program is commonly referred to as the Vernalis Adaptive Management Program (VAMP). Within the SJRA, the NMPIO is assumed to form part of the basis for which flows will be provided on the San Joaquin River to meet the 31-day pulse flow targets during April-May. Additional flows to meet the targets will be provide by other sources in the San Joaquin River under the control of other signatories of the SJRA.

16. Stanislaus River Hvdropower Operations

Power generation occurs when New Melones storage is above the minimum power pool of 300,000 AF. Reservoir levels are maintained whenever possible to provide maximum energy generation.

17. Stanislaus River Flood Control

New Melones Reservoir flood control operation is coordinated with the operation of Tulloch Reservoir. The flood control objective is to maintain flood flows at the Orange Blossom Bridge at less than 8,000 cfs. However, Reclamation attempts to operate New Melones Dam, whenever possible, to provide flows less than 1,500 cfs in order to prevent seepage and flooding problems associated with flows above this level. Up to 450,000 AF of the 2.4 MAF storage volume in New Melones Reservoir and 10,000 AF of Tulloch Reservoir storage is dedicated for flood control. According to Army Corps of Engineer requirements, part or all of the dedicated flood control storage may be used for conservation storage depending on the time of year and the current flood hazard.

18. CVP and SWP Delta Facilities

Delta operations of CVP and SWP facilities are largely determined by SWRCB decisions and orders. Reclamation and DWR currently operate CVP and SWP facilities in coordination with the water export facilities in the south Delta to comply with the terms and conditions of SWRCD Decision 990, Decision 1291, Decision 1485, and Order WR 95-6. Order WR 95-6 had the effect of temporarily making the CVP and SWP's water rights consistent with their voluntary compliance with the objectives in the 1995 Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary. On December 3, 1998, the SWRCB adopted Order WR 98-09 which temporarily extended Order WR 95-6, as modified, until adoption of a comprehensive water rights decision that allocates final responsibility for meeting 1995 Bay-Delta objectives or December 31, 1999, whichever came first. On December 29, 1999, the SWRCB adopted Decision 1641 (D-1641). D-1641 implements flow objectives for the Bay-Delta Estuary, approves a petition to change points of diversion of the CVP and SWP in the southern Delta, and approves a petition to change places of use and purposes of use of the CVP.

19. Central Valley Project Improvement Act

Operations of the CVP reflect actions taken in accordance with provisions of the CVPIA, particularly sections 3406(b)(l), (b)(2), and (b)(3). The October 6, 1999, Final Decision combined with the May 1997 AFRP Plan provide the basis for implementing upstream and Delta fish actions with CVP yield. The FWS has identified actions that contribute to the CVPIA goal of doubling the natural production of anadromous fish and FWS anticipates selecting actions from this list for the annual management of the 800,000 AF of yield dedicated under (b)(2). Not all the actions on this list will be implemented in any given year, but instead FWS will annually select the appropriate actions for use of (b)(2) water supplies based on biological needs, hydrologic circumstances, and water availability. To assist Reclamation and FWS in the accounting methodology, and the development and implementation of annual actions with (b)(2) water supplies, the Department of Interior has established a B2 Interagency Team (B2IT) consisting of representatives from DWR, DFG, Reclamation, FWS, and NMFS.

20. CALFED Framework Agreement and ROD

Water Year 2001 includes the first year of implementation of the Environmental Water Account (EWA) as specified in the CALFED Framework Agreement, dated June 9, 2000. This agreement sets aside 380,000 AF of water purchases and groundwater storage to assure the effectiveness of the EWA to protect endangered fish species. The management agencies, NMFS, CDFG, and FWS, are charged with managing these assets in coordination with project operators, Water Operations Management Team (WOMT), and the CALFED Operations Group. To date the EWA has been used to protect spring-run chinook salmon in the Delta and steelhead spawning in the American River.

C. Description of Proposed Operations of the Central Valley Project Facilities from January 1, 2001 through March 31, 2002

Information regarding the proposed operation of CVP facilities during the period between January 1, 2001 and March 31, 2002 was obtained from the following: 1) the November 2000 biological assessment with separate appendices A through I; 2) water year 2001 (90% exceedance with B(2) and EWA) forecast with and without the Shasta Criteria; 3) water year 2001 (50% exceedance with B(2)and EWA) forecast from Reclamation's Central Valley Office (CVO) web site January 2001; 4) February 15, 2001 water allocations and water temperature control for the Sacramento River (letter to Rebecca Lent); 5) water temperature models for Sacramento, American, Stanislaus, and Feather Rivers (based on January 2001 forecasts) provided during B(2)IT forecast meeting February 9, 2001; and 6) Water Year 2001 SWP/CVP Operations Plan including implementation of EWA and CVPIA b(2) actions.

The specific components of the Central Valley Project and State Water Project assessed in this biological opinion (Opinion) are as follows:

1. Trinity River Division

(a) Trinity and Lewiston Dams

Currently, based on a May 8, 1991 decision by the Secretary of the Interior, 340,000 acre feet is annually allocated for Trinity River flows. Exports of Trinity water to the Sacramento Basin are determined after consideration is given to forecasted Trinity water supply and Trinity in-basin needs, including carryover storage. Trinity exports provide increased water supply, power generation, and temperature control in the upper Sacramento River for the CVP. In Water Year 2001 through March 2002, the Reclamation proposes to coordinate the timing of Trinity exports with releases at Shasta to best meet temperature objectives on the upper Sacramento that were established in the 1993 NMFS winter-run biological opinion (WR Opinion).

(b) Whiskeytown Dam and Reservoir on Clear Creek

In Water Year 2001 through March 2002, the Reclamation proposes to operate Whiskeytown Dam to regulate inflows for power generation and recreation; to support upper Sacramento temperature objectives; and to provide releases to Clear Creek consistent with AFRP objectives except during June through September.

Under the 90% exceedance forecast monthly average flows are predicted to be 150 cfs from October through May and 50 cfs from June through September into Clear Creek. The proposed flows for October through May are based upon AFRP restoration objectives and are intended to increase fish passage and attraction into Clear Creek; decrease water temperatures; and increase spawning, incubation, rearing, and emigration habitat for fall and late fall chinook salmon and steelhead. However, the proposed flows for June through September are not based on AFRP restoration objectives that are intended to provide rearing habitat for steelhead and holding and spawning habitat for spring-run chinook salmon, but are based upon B(2) allocations and the 1963 release schedule that has previously been implemented by the Reclamation.

In November 2000 the McCormick-Saeltzer Dam at RM 6.5 was removed by the Department of the Interior to provide fish passage to upstream habitat below Whiskeytown Reservoir. Reclamation proposes to provide AFRP summer time flows of 100-150 cfs for fish passage upstream of the old dam. A monitoring program is being conducted by USFWS in conjunction with CDFG to provide Reclamation with recommendations for suitable flow releases for steelhead and spring-run salmon. Flushing flows to coincide with high storm events have been proposed to remove some of the accumulated sediments behind the removed dam. In the 90% exceedence forecast there may not be enough B(2) water to accomplish this in 2001 and keep Clear Creek flows above 50 cfs in the summer time. The Reclamation has not proposed any ramping criteria for Whiskeytown releases, but the USFWS has conducted a study involving ramping rates that could be used.

(c) Temperature control in Clear Creek

The Reclamation does not actively manage temperatures on Clear Creek, but monthly mean temperatures are predicted from January 2000 through December 2000 based on proposed WY 2001 flow conditions. Mean monthly temperatures for Whiskeytown releases are expected to be less then 60°F during the summer and winter. For both 90% and 50% exceedence forecast, mean monthly temperatures at the mouth of Clear Creek are below 56°F °from January through May and October through December, while temperatures from June through September range from 58 °F to 63 °F. However, if the flows are decreased to 50 cfs during the summer time the mean temperatures at the mouth of Clear Creek would be significantly increased.

2. Shasta Division

(a) Shasta Reservoir Storage

In Water Year 2001 through March 2002, the Reclamation proposes to operate the Shasta Reservoir level to meet the needs of the CVP (i.e., water delivery to irrigation districts, flood control, D-1485 water quality standards, fish and wildlife protection, etc.) and to meet the provisions of SWRCB Order 90-05 and the 1993 WRO. The forecasted water year for 2001 is classified as "critical". Predicted end-of-water-year 2001 carryover storage for Shasta Lake is less then the minimum storage (1.9 MAF) established in the 1993 WRO, triggering a reinitiation of consultation. In both 90% exceedance forecasts with and without the Shasta Criteria being met, the year end storage (September 30) is predicted to be 1.836 and 1.782 TAF, respectively. Under the 50% exceedance forecast the minimum end-of-year storage is exceeded (2.601 TAF).

(b) Minimum streamflows in the Upper Sacramento River

In Water Year 2001 through March 2002, the Reclamation proposes to provide release flows at Keswick Dam and Red Bluff Diversion Dam that are equal to, or exceed AFRP flows during most months under the 50% exceedance forecast. In the 90% exceedance forecasts January through March flows are held at the minimum (3250 cfs) requirements established in the 1993 WRO. The 1993 WRO did not require minimum flows from April through September, however, a minimum temperature criteria was established for these months resulting in the adaptive management of release flows by the Reclamation to achieve temperature compliance.

The Reclamation currently implements the ramping criteria established by the reasonable and prudent alternative of the WRO. Ramping constraints for Keswick release reductions are from July 1 through March 31 and include the following:

a. Releases must be reduced between sunset and sunrise.
b. When Keswick release is 6,000 cfs or greater, decreases may not exceed 15% per night. Decreases may also not exceed 2.5% in one hour.
c. For Keswick release between 4,000 to 5,999 cfs, decreases may not exceed 200 cfs per night. Decreases may also not exceed 100 cfs per hour.
d. For Keswick releases between 3,999 and 3,250 cfs, decreases may not exceed 100cfs per night.

Begining January 12, 2001 Keswick releases were decreased from 4,000 cfs to 3,250 cfs at the rate of 1 OOcfs per night as specified in the WRO in order to conserve cold water for the summer once inflow began dropping off. In accordance with the terms and conditions of the WRO a monitoring program was instituted by Reclamation and FWS to look for stranding and isolated winter run juveniles, none were found, however juvenile rainbow trout and spring-run size salmon were observed in several isolated side channels.

From October 15 to December 31, the Reclamation attempts to minimize changes in releases from Keswick Dam to provide stable flow conditions for fall-run chinook salmon production. Normally releases from Keswick Dam are reduced to the minimum fishery release requirement (either WRO or AFRP) by October 15 of each year. In the case of the 50% exceedence followed by a 90% exceedence forecast, the Reclamation proposes to provide 4200 cfs in November and 3750 in December which exceeds the minimum flows required by the WRO (3250 cfs) and AFRP.

Flood control operations and other emergencies are not affected by the release change limitations.

(c) Temperature control in the Upper Sacramento River

Since 1997, the Reclamation has used the Shasta temperature control device (TCD) to allow greater flexibility in the management of the cold water reserves in Shasta Lake while enabling hydropower generation. The TCD is designed to enable releases of water from varying lake levels through the powerplant to attempt to maintain adequate water temperatures in the Sacramento River downstream of Keswick Dam. In Water Year 2001 through March 2002, the Reclamation proposes to adaptively manage releases from Shasta Dam to achieve temperature compliance(56°F) at Jelly's Ferry for the 90% exceedence forecast pursuant to the WRO for the period of April 15 through September 30 and 60°F in October.

For the 50% exceedence forecast, predicted mean monthly Sacramento River temperatures for WY 2001 at Bend Bridge are below 56°F for all months (see temperature model forecast 2/9/01).

Pursuant to SWRCB Order 90-05 and 91-01, the Reclamation devised and implements the Sacramento-Trinity Water Quality Monitoring Network (see page 15 of the BA) which is used to monitor temperature and other parameters at key locations in the Sacramento and Trinity rivers. Also, as a result of the SWRCB Orders, the Sacramento River Temperature Task Group was convened by the Reclamation to formulate, monitor, and coordinate temperature control plans for the upper Sacramento and Trinity rivers with representatives from SWRCB, NMFS, USFWS, CDFG, WAPA, DWR, and the Hoopa Valley Indian Tribe.

(d) Wilkins Slough

Wilkins Slough is located on the mainstem Sacramento River immediately upstream of the confluence with the Feather River. While commercial navigation is no longer a concern on the lower Sacramento River, the 5,000 cfs minimum flow established at Chico Landing for navigation served as the basis for the design of many irrigation pumping stations on this reach of the river. Diverters are able to operate for extended periods at flows as low as 4,000 cfs at Wilkins Slough, but pumping operations become severely affected at flows lower than this. In WY 2001 through March 2002, the Reclamation's proposed flows for the 50% and 90% exceedance forecast do not meet the 5,000 cfs minimum flow at Wilkins Slough during January through March and November through December.

(e) Spring Creek Debris Dam

In WY 2001 through March 2002, the Reclamation proposes to implement actions that will protect the Sacramento River system from heavy metal pollution from Spring Creek and adjacent watersheds. These actions were identified in a 1980 MOU established between the Reclamation, CDFG, and the SWRCB. According to the MOU, when storage within Spring Creek Reservoir is less than 5,000 af, the Reclamation is able to make controlled releases that result in allowable concentrations of total copper and zinc in the Sacramento River below Keswick Dam. When storage within Spring Creek Reservoir is more than 5,000 af, the MOU provides for "emergency" relaxation of the objective concentrations of copper and zinc. However, the Reclamation and CDFG have agreed not to use the emergency criteria until a spill occurs. The MOU states that Reclamation agrees to operate according to the established criteria and schedules as long as operations will not cause flood control parameters on the Sacramento River to be exceeded or interfere unreasonably with other project requirements as determined by the Reclamation. The Reclamation also has primary responsibility for monitoring concentrations of copper and zinc at Spring Creek Debris Dam and in the Sacramento River below Keswick Dam. CDFG and the WRQCB also collects and analyzes samples on an as-needed basis.

(f) Anderson-Cottonwood Irrigation District Dam

In WY 2001 through March 2002, the Reclamation proposes to meet the contractual obligations with ACID by manipulating Keswick Dam releases to the extent reasonably needed to facilitate installation, removal, or adjustment of the flashboards. Around April 1 of each year, ACID erects the diversion dam by raising the steel superstructure, installing the walkway, and then setting the boards in place. Around November 1, the reverse process is performed. During the irrigation season, adjustment of the boards may be necessary due to changes in releases at Keswick Dam. Because work on the ACID dam can not be safely accomplished at flows greater than 6,000 cfs (April through September), the Reclamation proposes to limit Keswick releases at the request of ACID to 5,000 cfs for five days to facilitate installation or removal of the dam.

The Reclamation proposes to operate Keswick Flow decreases for ACID operations to meet the reasonable and prudent alternative for flow decreases identified in the WRO. This RPA specifies flow decreases are limited to 15% in a 12 hour period (releases limited between sunset to sunrise) and 2.5% in any one hour. Therefore, advance notification is necessary between the Reclamation and ACID when scheduling decreases for installation or removal of the ACID dam.

3. Sacramento River Division

(a) Red Bluff Diversion Dam

In WY 2001 through March 2002, the Reclamation proposes to operate the RBDD to meet the reasonable and prudent alternative for RBDD operation identified in the WRO. This RPA specifies that the Red Bluff gates will be raised from September 15 through May 14 with a provision that intermittent gate closures up to ten days may be approved on a case-by-case basis for critical diversion needs. Reclamation has been involved with a pilot pumping plant to provide water to the Tehama-Colusa Canal during this period when the gates are raised. These pumps have proven to adequately screen juvenile salmonids but are not large enough to meet irrigation demands, therefore since 1992 water has been made available from Black Butte Reservoir via Stony Creek. The operation of RBDD from July through September in a closed position requires the majority of spring-run adult salmon and a small part of the early steelhead run to use the ladders at RBDD when flows are usually at their highest level.

4. American River Division

(a) Folsom Dam and Reservoir (Folsom Lake)

From WY 2001 through March 2002, Reclamation proposes to operate the Folsom Reservoir level to meet the needs of the CVP (i.e., water delivery to downstream water rights, D-1641 water quality standards, fish and wildlife protection, water supplies to CVP contractors, etc.) and to meet the provisions of SWRCB Order 95-1 WR.

Predicted end-of-water year storage for Folsom Lake is 575 TAF for the 50% exceedance forecast and 328 TAF in the 90% forecast. Folsom Dam releases into the American River are re-regulated approximately 7 miles downstream by Nimbus Dam.

Through CVPIA, Reclamation funded a study in 1998 conducted by CDFG to better define criteria for fluctuating flows in the lower American River. A report was due by the end of 2000 and until recommendations are made for steelhead and chinook spawning flows the Reclamation proposes to use the American River Operations Group (AROG) recommendations and ramping rate criteria to reduce the incidence of anadromous fish stranding and dewatering.

(b) Nimbus Dam and Reservoir (Lake Natoma)

In Water Year 2001 through March 2002, the Reclamation proposes to operate the Nimbus Reservoir to serve as a forebay for the diversion of water through the Folsom South Canal and to provide releases to the lower American River. The Folsom South Canal serves water to agricultural and M&I users in Sacramento and San Joaquin counties. Releases from Nimbus Dam to the American River pass through the Nimbus Powerplant (5,000 cfs capacity) or, at flows in excess of 5,000 cfs, the spillway gates.

(c) Minimum streamflows in the lower American River

Reclamation proposes to provide monthly average release flows from Nimbus Dam that are equal to, or exceed AFRP flows during most months, however, under the 90% exceedance forecast, February (850 cfs) and March (830 cfs) releases would be below AFRP minimums. Steelhead redds made in January, 2001, at 1,750 cfs would be dewatered at these significantly decreased flows. Under the 50% exceedance forecast, proposed monthly average flows are adequate. AFRP flow objectives in the American River are intended to decrease water temperatures and increase spawning, incubation, rearing, and emigration habitat for fall chinook salmon and steelhead while providing benefits for estuarine species as well.

Operation of the Nimbus Fish Diversion Weir for fall-run chinook salmon spawning at the Nimbus Hatchery requires Reclamation to lower the flows in October to between 500 and 1000 cfs for up to two days to facilitate repair and installation. Construction of a new prototype replacement weir will begin in September 2001 with a permanent weir planned for completion in

2002. Construction work in order to install the prototype and permanent weir will require Reclamation to lower the flows for increasingly longer periods in the next two years.

(d) Temperature control in the lower American River

Although the Reclamation proposes to implement AFRP flows during Water Year 2001 through March 2002, temperature control problems exist in the lower American River due to the small size of the cold water pool available within the Folsom Reservoir for downstream releases. Reclamation proposes to continue adaptively managing temperatures on the lower American River using a combination of flow releases and shutter operations with the assistance of the American River Operations Group.

Temperature goals within the lower American River are to provide suitable temperatures during the summer months for Nimbus Fish Hatchery and for instream rearing juvenile steelhead, while minimizing the loss of the cold water pool left available for spawning fall-run chinook. In WY 2000 efforts made by Reclamation and the AROG to maintain 65°F water temperatures at Watt Ave succeeded in avoiding lethal temperatures for both juvenile steelhead and fall-run chinook spawners.

Under the 50% exceedance forecast, mean weekly temperatures predicted at Watt Avenue Bridge (the reach containing the majority of known steelhead spawning and rearing habitat) are below 65 °F from January through December. In the 90% exceedance forecast, mean weekly water temperatures exceed the lethal limit for steelhead (70°F) in two of the three alternatives modeled (summer shutter operations for steelhead and fall shutter operations for salmonids). The third temperature alternative (unconstrained operation) reached 69°F at Watt Ave from March through September.

Reclamation is pursuing a temperature control device (TCD) for the water supply intake at Folsom Dam to allow greater flexibility in the management of cold water reserves in Folsom Lake while enabling hydroelectric power generation. The objective of the TCD is to allow Reclamation to draw warm water off Folsom Reservoir without impacting the cold water pool. The project was authorized in September of 1998 and is scheduled to be completed in 2001.

In addition, the Army Corps of Engineers (Corps) has been authorized by Congress to begin a major construction project in 2001 to enlarge the Folsom Dam outlets and increase surcharge storage space for greater flood control.

5. Eastside Division

(a) New Melones Dam And Reservoir

In Water Year 2000 through March 2002, the Reclamation proposes to operate the New Melones Reservoir level to meet the needs of the CVP (i.e., water delivery to downstream water rights, flood control, D-1485, water quality standards, fish and wildlife protection, water supplies to CVP contractors, Vernalis water quality, recreation, etc.). Predicted end-of-water year storage for New Melones is 1.5 MAF for the 50% exceedance forecast and 1.2 MAF for the 90% exceedance forecast (2.4 MAF capacity). New Melones Dam releases pass through the New Melones Powerplant into the Stanislaus River where flows are re-regulated approximately 6 miles downstream by Tullock Dam. Tullock Dam releases pass through the Tullock Powerplant into the Stanislaus River where flows are re-regulated approximately 1.9 miles downstream at Goodwin Dam.

Goodwin Reservoir serves as a forebay for the diversion of water to several irrigation districts and it also provides releases to the lower Stanislaus River. Diversions from Goodwin Reservoir include two canals running north and south of the Stanislaus River that serve water to the Oakdale Irrigation District and the South San Joaquin Irrigation District and include the Goodwin Tunnel that delivers water to the Central San Joaquin Water Conservation District and the Stockton East Water District.

(b) Minimum streamflows in the lower Stanislaus River

In Water Year 2001 through March 2002, the Reclamation proposes to operate New Melones according to the New Melones Interim Plan of Operation (NMIPO). The NMIPO was developed as a joint effort between the Reclamation and USFWS, in conjuction with the Stanislaus River Basin Stakeholders (SRBS). It defines categories of water supply based on storage and projected inflow, then allocates annual water releases for fishery, water quality, bay-delta, and use by CVP contractors (see pages 29 - 32 in the BA).

AFRP flow volumes on the lower Stanislaus River, as part of the NMPIO, are determined based on the New Melones end of February storage plus forecasted March to September inflow as shown in the NMPIO (see table 1-3 and 1-4 in the BA). The AFRP volume is then initially distributed based on modeled AFRP distributions and patterns used in the NMPIO. The final AFRP flow distributions are determined based on Reclamation and USFWS coordination and consultation with CDFG.

The proposed flows for Water Year 2001 through March 2002 under the 50% exceedance forecast meet the AFRP flow recommendations. Under the 90% exceedance forecast flows would be reduced in all months with a significant reduction (1500 to 870 cfs) in April and May VAMP flows and a low point in October of 129 cfs.

(c) Seasonal fluctuations and ramping of streamflows in the Stanislaus River.

The Reclamation did not propose any ramping criteria for Goodwin Dam releases. However, the USFWS has suggested that Reclamation use the ramping criteria developed for the Trinity River by the USFWS on the Stanislaus River until a basin specific criteria can be developed. The

USFWS proposed the use of this criteria because the Stanislaus River has characteristics similar to the Trinity River.

(d) Temperature control in the Stanislaus River.

The Reclamation does not actively manage temperatures on the lower Stanislaus River. However, for both the 50% and 90% exceedance forecast, mean monthly temperatures from June though September are predicted to be at, or above, 65 °F at Oakdale (current extent of suitable rearing habitat) based on proposed flow conditions.

D. Description of the Proposed Operations of the State Water Project Facilities from January 1, 2001 through March 31, 2002

1. <u>Feather River Division</u>

(a) Oroville Thermalito Complex

In Water Year 2001 through March 2002, the DWR proposes to operate the reservoir level to meet the needs of the SWP (i.e., water delivery to irrigation districts, flood control, power generation, recreation, D-1485 water quality standards, fish and wildlife protection, etc.). Flows are released from Oroville primarily through the Edward Hyatt Powerplant (17,000 cfs capacity) where most flows are then diverted through the Thermalito Power Canal and Powerplant (17,000 cfs capacity) with the exception of 600 cfs diverted to the low flow channel. The Edward Hyatt Powerplant and the Thermalito Powerplant are operated in tandem to maximize power generation. During periods of peak power demands, water releases in excess of local and downstream requirements are conserved in storage at Thermalito Forebay and are pumped back during off-peak hours through both Powerplants into Lake Oroville to generate additional power. Pumpback operations only occur when it is economically advantageous and commonly occurs during periods when energy prices are high during on-peak hours of the weekdays and low during the off-peak hours or on weekends.

Southern California Edison (SCE) has a contract with DWR for 35 to 45% of the Hyatt-Thermalito Complex power generation. Also as part of the contractual agreement, SCE may increase its generation potential by pumping back at night and generating during the day during periods when it is economically advantageous to use pumpback operations.

Predicted end-of-water year storage for Lake Oroville for the 50% forecast is 1.6 MAF and for the 90% forecast is 1.1 MAF (3.5 MAF capacity).

(b) Feather River Minimum Streamflows

In Water Year 2001 through March 2002, the DWR proposes to provide year-round monthly average flows of 600 cfs under the 50% exceedence forecast for the reach of the Feather River between the Feather River Hatchery Dam and the Thermalito Afterbay (known as the low flow channel) based upon criteria established in a 1983 agreement between DWR and CDFG, "Concerning the Operation of the Oroville Division of the State Water Project for Management of Fish & Wildlife" (see Appendix B of the BA). The minimum flow required in the low flow channel is 600 cfs under this agreement. This reach is most heavily used by salmon and steelhead for instream spawning and rearing.

In Water Year 2001 through March 2002, the DWR also proposes to provide at least the minimum flow requirements that were established in this agreement for the reach of the Feather River between the Thermalito Afterbay and Verona under the 50% exceedence forecast. Minimum flow requirements between the Thermalito Afterbay and Verona vary for different times of the year, but can go as low as 750 cfs when storage falls below 1.5 MAF (see Appendix B of the BA). In the 90% forecast releases are predicted to be 840 cfs for April, 813 cfs for May, and 976 cfs in December.

(c) Feather River seasonal fluctuations and ramping of Streamflows

The DWR did not propose any ramping criteria for Oroville releases within the low flow channel. According to the 1983 agreement between DWR and CDFG (see Appendix B of the BA), when flows below Thermalito Afterbay are less than 2500 cfs, they can not be reduced more than 200 cfs during any 24-hour period, except for flood control releases, failures, etc.

(d) Feather River temperature control

In Water Year 2001 through March 2002, the DWR proposes to meet the temperature criteria that were established in the 1983 agreement between DWR and CDFG (see Appendix B of the BA). Varying temperature criteria were specified in the agreement for two different locations within the Feather River; the Feather River Hatchery and the reach of the Feather River between the Thermalito Afterbay and Verona. Temperature criteria for the Feather River Hatchery were specified to provide suitable temperatures within the hatchery for raising chinook salmon and steelhead. The hatchery is located at the upstream end of the reach of the Feather River known as the low flow channel (extends between the Feather River Hatchery Dam and the Thermalito Afterbay), so temperatures within the low flow channel are influenced by the temperature requirements necessary for the Hatchery, Temperature criteria between Thermalito and Verona were specified to provide suitable temperatures during the fall months (after September 15) for fall-run chinook salmon and suitable temperatures from May through August for shad, striped bass, etc.

For the 50% and 90% exceedence forecast, monthly average temperatures are predicted to be less than 56°F within the low flow channel from September through May. In the 50% forecast monthly average temperatures predicted at the downstream end of the low flow channel for May and September are 64.1 °F and 63.5°F, respectively. Predicted monthly average temperatures at the downstream end of the low flow channel for June through August range from 67.6°F to

69.1 °F. In the 90% forecast monthly average temperatures predicted at the downstream end of the low flow channel for May and September are 63.9°F and 67.0°F, respectively, and June through August range from 69.1°F to 73.1°F.

E. Description of the Proposed Operations of Central Valley Project and State Water Project Delta Facilities from January 1, 2001 through March 31, 2002

Information regarding the proposed operation of CVP and SWP Delta facilities during the period between January 1, 2001 and March 31, 2002, was obtained from the following: 1) the November 2000 biological assessment and separate appendices A through I; 2) water year 2001 (90% exceedance with b(2) and EWA) forecast dated February 15, 2001; 3) water year 2001 (50% exceedance with b(2) and EWA) forecast; and 4) the Fall/Winter Juvenile Salmon Decision Process (October 1 through January 31, 2001 . For the period of January 1, 2001 through March 31, 2002, the proposed operations of CVP and SWP Delta facilities assessed in this biological opinion are as follows:

1. CVP Export Facilities and Associated Tracy Fish Collection Facility

Reclamation proposes to operate the Tracy Pumping Plant and Tracy Fish Collection Facility in compliance with SWRCB D-1641, the NMFS February 12, 1993, WR Opinion (as amended), the FWS March 6, 1995, biological opinion for delta smelt, the CALFED Operations Group, the October 1 through January 31, 2001 Fall/Winter Juvenile Salmon Decision Process (formerly known as the Spring-run Protection Plan), and the October 6, 1999, FWS Final Decision. The Tracy Pumping Plant will typically operate at or near its maximum rate of 4,600 cfs except during periods of low Delta inflow, curtailments for the Spring-run Protection Plan, implementation of CVPIA (b)(2) fisheries actions, or curtailments for water quality exceedances.

The Tracy Fish Collection Facility will be operated to intercept fish before they pass through the canal to the Tracy Pumping Plant. Fish passing through the facility will be sampled at intervals no less than 10 minutes every 2 hours. Fish observed during sampling intervals will be identified to species, measured to fork length, examined for marks or tags, and placed in the collection facilities for transport by tanker truck to release sites away from the pumps. All other fish passing through the facility will be collected and transported by tanker truck to Delta release sites away from the pumps. To the extent possible, the louvers of the fish collection facility will be operated to meet water approach velocities established for salmon of approximately three feet per second from November 1 through May 14.

Reclamation recognizes that Delta export operations must be coordinated with other actions and programs in the Delta and Central Valley. Through the CALFED Operations Group, NMFS and the other CALFED agencies will be updated monthly on Reclamation's Delta operations and participate in decisions which involve change in export rates, barrier operations, or reservoir releases. The CALFED Operations Group will also serve to distribute information regarding CVPIA (b)(2) water actions.

2. SWP Export Facilities. Clifton Court Forebav. and Associated Skinner Fish Protection Facility

DWR proposes to operate the Banks Pumping Plant and Skinner Fish Protection Facility in compliance with SWRCB D-1641, the NMFS February 12, 1993, WR Opinion (as amended), the FWS March 6, 1995, biological opinion for delta smelt, and the October 1 through January 31, 2001 Fall/Winter Juvenile Salmon Decision Process. The November 2000 project description also indicates the 2000/2001 DWR operations plan includes implementing the Delta and upstream reservoir CVPIA (b)(2) actions as described in the November 20, 1997, Final Administrative Proposal on the Management of Section 3406(b)(2) Water, in a manner that reduces potential water supply impacts on Delta actions. Although, this Administrative Proposal has been subsequently superceded by the October 6, 1999, Final Decision, the fisheries protection actions are basically the same and a process to facilitate implementation and ensure (b)(2) actions do not adversely affect the SWP remain in place. DWR recognizes the (b)(2) actions in the Delta can not be successfully implemented without the coordination and cooperation of the SWP and, thus, DWR remains fully engaged in the process to coordinate operations and develop tools to avoid or minimize water supply impacts.

In December 2000 the CALFED ROD was completed, creating the Environmental Water Account (EWA) to be used in conjunction with the CVPIA b(2) actions to protect endangered fish species. For purposes of this consultation, use of the EWA has only been described in the forecasting and in the Fall/Winter Juvenile Salmon Decision Process (dated November 14, 2000). Initial EWA actions have yet to be evaluated and are not included in the November 2000 BA. In Water Year 2001 EWA actions were taken to curtail exports during key fish migration intervals with most of the EWA cost being applied to the SWP while b(2) actions were applied to the CVP.

The Banks Pumping Plant will operate up to its maximum permitted rate of 6,680 cfs except during periods of low Delta inflow, curtailments for the Fall/Winter Juvenile Salmon Decision Process, implementation of CVPIA (b)(2) fisheries actions, curtailments for water quality exceedances, or reduced demand. During the period between December 15 and March 15, the Banks Pumping Plan may operate above 6,680 cfs to export one-third of the total flow of the San Joaquin River as measured at Vernalis when its total flow exceeds 1,000 cfs. Under the 50% exceedance forecast, DWR forecasts the SWP share of San Luis Reservoir will be filled in late March 2001. Under the 90% exceedance forecast, the SWP share of San Luis Reservoir is never filled in 2001. Upon filling the SWP portion of San Luis Reservoir, DWR predicts pumping at Banks will be reduced to a lower level to support exports for CVP Cross Valley supplies and delivery of an "undetermined" amount of interruptible supplies to SWP contractors.

The Skinner Fish Protection Facility will be operated to intercept fish before they pass down the California Aqueduct to the Banks Pumping Plant. Fish passing through the facility will be sampled at intervals no less than 10 minutes every 2 hours. Fish observed during sampling intervals will be identified to species, measured to fork length, examined for marks or tags, and placed in the collection facilities for transport by tanker truck to release sites away from the pumps. All other fish passing through the facility will be collected and transported by tanker truck to Delta release sites away from the pumps. To the extent possible, the louvers of the fish collection facility will be operated to meet water approach velocities established for salmon of approximately three feet per second from November 1 through May 14.

DWR also recognizes that Delta export operations must be coordinated with other actions and programs in the Delta and Central Valley. Through the CALFED Operations Group, NMFS and the other CALFED agencies will be updated monthly on DWR's Delta operations and participate in decisions which involve any change in export rates, barrier operations, or reservoir releases.

3. <u>CVP and SWP Delta Exports and San Luis Reservoir Storage</u>

Based on the January, 2001 forecast, a summary of Delta water export operations and San Luis Reservoir storage from January through December 2001, under a 90% exceedence forecast and 50% exceedence forecast are presented in Tables 2 and 3, respectively. Under the 90% exceedence forecast, Reclamation and DWR propose to export approximately 1,078,000 AF of water and total San Luis Reservoir storage will reach approximately 1,820,000 AF at the end of March 2001. Under the 50% exceedence forecast, Reclamation and DWR propose to export 1,452,000 AF and total San Luis Reservoir storage will reach approximately 1,976,000 AF at the end of March 2001.

Table 2. Delta Operations Summary and San Luis Storage (TAF) under 90% Exceedence Forecast

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Tracy Export	171	148	128	56	46	49	87	137	181	210	192	249
Banks Export							13	13	12			
Contra Costa Export	3	5	6	8	10	22	14	14.4	12	8	3	3
State Export	335	162	120	15	46	8	56	21	47	94	104	171
Total Export	509	315	254	79	102	79	170	185	252	312	299	423
Excess Outflow	99	88	59		8							
% E/I Divert.	59.0	39	29	11	13	8	23	25	36	43	48	61
Fed SL Stor.	961	962	961	852	689	456	241	80	93	165	240	452
State SL Stor	786	853	859	739	620	443	282	104	43	43	68	169
Total SL Stor	1748	1815	1820	1591	1309	899	523	184	136	207	308	621

Table 3. Delta Operations Summary and San Luis Reservoir Storage (TAF) under a 50% Exceedence Forecast.

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Tracy Export	173	153	171	97	77	125	283	283	268	264	250	258
Banks Export							26	26	25			
Contra Costa Export	3	5	6	8	10	22	14	14.4	12	8	3	3
State Export	398	356	186	47	55	38	296	288	246	214	260	409
Total Export	574	515	363	152	142	185	619	611	551	486	513	670
Excess Outflow	520	734	660	7	211							56
% E/I Divert.	40	27	20	12	12	19	46	50	54	53	59	65
Fed SL Stor.	962	962	962	841	637	369	233	120	189	283	385	595
State SL Stor	791	999	1014	798	574	251	143	44	57	85	181	447
Total SL Stor	1753	1962	1976	1639	1212	621	375	164	247	368	566	1042

Under the 90% exceedence forecast, the export/inflow (E/I) ratios remain near or at the maximum rate permitted by the SWRCB under D-1641. The Federal side of San Luis storage fills and encroaches upon the SWP share (approximately 1.07 MAF) which never fills. Under the 50% exceedence forecast, the E/I ratio remains significantly below the maximum rate permitted by D-1641 in all months and DWR almost fills the SWP share of San Luis storage in March. Upon filling the SWP share of San Luis storage, SWP exports are reduced considerably during January, February, and March. Reclamation fills the CVP share of San Luis storage under the 50% exceedence forecast in January.

4. CVPIA Proposed Delta Actions

For December 2000 through January 2001, Delta actions were developed by members of the B2IT and EWA team to provide protection for Central Valley spring-run chinook salmon and to provide a concurrent evaluation of salmon smolt survival (the B2IT was established by the October 6, 1999, Final Decision and includes biologists with NMFS, DFG, FWS, Reclamation, and DWR). For spring-run chinook protection, the B2IT proposed a 5-day export reduction be implemented at the CVP's Tracy Pumping Plant when monitoring results in the lower Sacramento River and Delta indicate that marked and wild juvenile salmon are migrating through the Delta. In conjunction with the export reduction, a salmon survival evaluation would also occur. The target export rate for the December/January reduced export period and evaluation ranges from 6,000-8000 cfs. A second 3-day evaluation was overlaid during January with a proposed target export rate of 3,000 cfs. In total, FWS estimates that 200,000-300,000 AF of (b)(2) water supplies are available to reduce CVP pumping during December and January, and these supplies are anticipated to allow for export reductions to this extent under a 50% exceedance forecast.

As discussed in Attachment 2 of the October 6, 1999, Final Decision, flexibility has been incorporated into both the December and January (b)(2) actions to maximize the benefits to wild juvenile salmon outmigrants, accommodate CVP and SWP operational constraints, adhere to the (b)(2) accounting process and budget, and address hydrological and biological uncertainties. In coordination with the B2IT, FWS and Reclamation may modify actual export rates, duration, and schedule of these pumping curtailments.

5. CALFED Operations Group- Fall/Winter Juvenile Salmon Decision Process

From October 1, 2000, through January 31, 2001, Reclamation and DWR propose to operate the CVP and SWP Delta pumping plants and the Delta Cross Channel (DCC) gates in compliance with the CALFED Operations Group- Fall/Winter Juvenile Salmon Decision Process (formerly the Spring-Run Protection Plan). This plan was developed by DWR and Reclamation with the assistance of the CALFED Operations Group to comply with the California Fish and Game Commission's Special Order related to spring-run chinook incidental take authorization under the California Endangered Species Act. This plan includes monitoring of juvenile salmon movements in the lower Sacramento River and Delta, data assessment procedures, specific indicators of spring-run chinook vulnerability to impacts from Delta pumping, and operation responses to minimize the effects of Delta export pumping. Three specific indicators are presented in the plan: (1) First Alert requires the Data Assessment Team (DAT) to analyze and report the results of fisheries monitoring programs; (2) Second Alert requires the closure of the Delta Cross Channel gates for specific periods of time dependant on the Catch Index; and (3) DAT recommends export curtailments dependant on fish salvage results at the CVP/SWP facilities in five day increments.

6. Delta Cross Channel

During the period of January 1, 2001, through March 31, 2002, DCC gates will be closed by Reclamation for the protection of fish provided that water quality is not a concern in the central or south Delta. From February 1 through May 20, the SWRCB D-1641 requires the DCC gates remain closed for the protection of emigrating juvenile salmon in the Sacramento River. In addition D- 1641 requires the DCC gates to be closed for a total of 14 days during the May 21 through June 15 period after consultation with FWS, NMFS and DFG.

7. North Bay Aqueduct Intake at Barker Slough

DWR proposes to operate the North Bay Aqueduct intake in the range from 30 to 140 cfs. Project deliveries during 2001 are expected to be no more than 27,500 AF in the 90%

Exceedance forecast and 41,776 in the 50% exceedance forecast. However, if DWR were to deliver the full contracted amount, deliveries could be as high as 70,000 AF.

8. Suisun Marsh Salinity Control Gates

DWR may operate the Suisun Marsh Salinity Control Gates (SMSCG) during the period covered under this opinion from January 1, 2001, through March 1, 2002, but will only operate the SMSGC as needed to meet SWRCB and Suisun Marsh Preservation Agreement water quality standards. The non-operation configuration of the SMSCG during this period typically consists of the flashboards installed, but the radial gate operation is stopped and held open. Flashboards will be removed if it is determined that salinity conditions at all trigger stations would remain below standards for the remainder of the control season through May 31.

9. Rock Slough

Reclamation proposes that CCWD will operate the Contra Costa Canal and Rock Slough intake to divert less then 22 TAF per month for a total of 98.4 TAF in WY 2001. Under the 50% and the 90% exceedence forecast (dated January 19, 2001) the total water diverted remains the same. In general, CCWD's total diversions from the Delta will be reduced in drier periods when water quality and flows are low.

10. SWP Delta Pumping Plant Fish Protection Agreement (4-Pumps Agreement)

Pursuant to the December 30, 1986, SWP Delta Pumping Plant Fish Protection Agreement (4-Pumps Agreement), DWR and DFG have approved four projects for a total of $20 million that include quantified benefits to Central Valley spring-run chinook salmon and steelhead. Three of the four projects have been implemented and are totally, or partially funded by the 4-Pumps Mitigation Agreement. These four projects are: (1) enhanced law enforcement efforts from San Francisco Bay upstream into the Sacramento and San Joaquin tributaries ($5.1 million); (2) construction of fish screens and ladders on Butte Creek, Durham Mutual and Parrot Phelan Projects to cover short falls in funding ($6.6 million); (3) Mill and Deer Creek Water Exchange projects to switch irrigators from stream diversions to groundwater ($3.8 million); and 4) spawning habitat enhancement in the San Joaquin tributaries. The Mill Creek project was completed in 1992 and has been funded annually at approximately $35,000 per year. A pilot project for Deer Creek, using two of the ten pumps proposed, is scheduled for completion in 2001 at an estimated cost of approximately $40,000 per year.

DFG and DWR have also approved two other 4-Pumps salmon projects to off-set losses at the SWP Delta pumps; the eradication of northern pike from Lake Davis ($1.2 million), and addition of ten game wardens to reduce poaching in the Delta which were funded in 1999. Other projects funded by the 4-Pumps Agreement that may benefit spring-run chinook salmon are eight fish screens in Suisun Marsh ($2.4 million) and the removal of salmonid predator habitat on San Joaquin tributaries which should secondarily benefit steelhead ($3.6 million).

II. Status of the Species

Central Valley (CV) spring-run chinook salmon *(O. tshawytscha)* are listed as threatened under the ESA (September 16, 1999, 64 FR 50394). This ESU consists of spring-run chinook salmon occurring in the Sacramento River Basin. Designated critical habitat for CV spring-run chinook salmon includes all river reaches accessible to listed chinook salmon in the Sacramento River and its tributaries in California, except for reaches on Indian tribal lands. Also included are river reaches and estuarine areas of the Sacramento-San Joaquin Delta, all waters from Chipps Island westward to Carquinez Bridge, including Honker Bay, Grizzly Bay, Suisun Bay, and Carquinez Strait, all waters of San Pablo Bay westward of the Carquinez Bridge, and all waters of San Francisco Bay (north of the San Francisco/Oakland Bay Bridge) from San Pablo Bay to the Golden Gate Bridge. This critical habitat designation includes all waterways, substrate, and adjacent riparian zones. Excluded are: (1) areas above specific dams identified in the Federal Register notice; (2) areas above longstanding, natural impassable barriers (i.e., natural waterfalls in existence for at least several hundred years); and (3) Indian tribal lands (February 16, 2000, 65 FR 7764).

Central Valley (CV) steelhead *(O. mykiss)* are listed as threatened under the ESA (March 19, 1998, 63 FR 13347). This ESU consists of steelhead populations in the Sacramento and San Joaquin River Basins in California's Central Valley. Designated critical habitat for CV steelhead includes all river reaches accessible to listed steelhead in the Sacramento and San Joaquin rivers and their tributaries in California, except for reaches on Indian tribal lands. Also included are river reaches and estuarine areas of the Sacramento-San Joaquin Delta, all waters from Chipps Island westward to Carquinez Bridge, including Honker Bay, Grizzly Bay, Suisun Bay, and Carquinez Strait, all waters of San Pablo Bay westward of the Carquinez Bridge, and all waters of San Francisco Bay (north of the San Francisco/Oakland Bay Bridge) from San Pablo Bay to the Golden Gate Bridge. Excluded are: (1) areas above specific dams identified in the Federal Register notice; (2) areas above longstanding, natural impassable barriers (i.e., natural waterfalls in existence for at least several hundred years); (3) Indian tribal lands; and (4) areas of the San Joaquin River upstream of the Merced River confluence (February 16, 2000, 65 FR 7764).

Following are descriptions of the general life histories and population trends of listed species that may be directly or indirectly affected by the proposed action.

A. Chinook Salmon

1. <u>General Life History</u>

Chinook salmon historically ranged from the Ventura River in southern California north to Point Hope, Alaska, and in northeastern Asia from Hokkaido, Japan to the Anadyr River in Russia (Healey 1991).

Of the Pacific salmon, chinook salmon exhibit arguably the most diverse and complex life history strategies. Healey (1986) described 16 age categories for chinook salmon, 7 total ages with 3 possible freshwater ages. Two generalized freshwater life-history types were described by Healey (1991): "stream-type" chinook salmon reside in freshwater for a year or more following emergence, whereas "ocean-type" chinook salmon migrate to the ocean within their first year.

Chinook salmon mature between 2 and 6+ years of age (Myers *et al.* 1998). Freshwater entry and spawning timing are generally thought to be related to local water temperature and flow regimes (Miller and Brannon 1982). Runs are designated on the basis of adult migration timing; however, distinct runs also differ in the degree of maturation at the time of river entry, thermal regime and flow characteristics of their spawning site, and actual time of spawning (Myers *et al.* 1998). Spring-run chinook salmon tend to enter freshwater as immature fish, migrate far upriver, and finally spawn in the late summer and early autumn. Fall-run chinook salmon enter freshwater at an advanced stage of maturity, move rapidly to their spawning areas on the mainstem or lower tributaries of the rivers, and spawn within a few days or weeks of freshwater entry (Healey 1991).

Central Valley spring-run chinook salmon adults are estimated to leave the ocean and enter the Sacramento River from March to July (Myers *et al.* 1998). Spring-run chinook spawning typically occurs between late-August and early October with a peak in September. Spawning typically occurs in gravel beds that are located at the tails of holding pools (USFWS 1995). Eggs are deposited within the gravel where incubation, hatching, and subsequent emergence takes place. The upper preferred water temperature for spawning adult chinook salmon is 55° F (Chambers 1956) to 57° F (Reiser and Bjornn 1979). Length of time required for eggs to develop and hatch is dependant on water temperature and is quite variable. In Butte and Big Chico creeks, emergence of spring-run chinook typically occurs from November through January. In Mill and Deer creeks, colder water temperatures delay emergence to January through March (CDFG 1998).

Post-emergent fry seek out shallow, nearshore areas with slow current and good cover, and begin feeding on small terrestrial and aquatic insects and aquatic crustaceans. In Deer and Mill creeks, juvenile spring-run chinook usually spend 9-10 months in their natal streams, although some may spend as long as 18 months in freshwater. Most "yearling" spring-run chinook move downstream in the first high flows of the winter from November through January (USFWS 1995; CDFG 1998). In Butte and Big Chico creeks, spring-run chinook juveniles typically exit their natal tributaries soon after emergence during December and January, while some remain throughout the summer and exit the following fall as yearlings. In the Sacramento River and other tributaries, juveniles may begin migrating downstream almost immediately following emergence from the gravel with emigration occurring from December through March (Moyle, *et al.* 1989; Vogel and Marine 1991). Fry and parr may spend time rearing within riverine and/or estuarine habitats including natal tributaries, the Sacramento River, non-natal tributaries to the Sacramento River, and the Delta.

Chinook salmon spend between one and four years in the ocean before returning to their natal streams to spawn (Myers *et al.* 1998). Fisher (1994) reported that 87 percent of returning spring-run adults are three-years-old based on observations of adult chinook trapped and examined at Red Bluff Diversion Dam between 1985 and 1991.

Adult Sacramento River winter-run chinook salmon leave the ocean and migrate through the Sacramento-San Joaquin Delta to the upper Sacramento River from December through June. Spawning generally occurs between mid-April and July, and occasionally into early August. The majority of winter-run chinook salmon spawning occurs upstream of Red Bluff Diversion Dam in the vicinity of Redding, California. The eggs are fertilized and buried in the river gravel where they incubate and hatch in approximately a two-month period.

Emergence of the fry from the gravel begins during early July and continues through September. Fall and winter emigration behavior by juveniles varies with streamflow and hydrologic conditions. Most juveniles redistribute themselves to rear in the Sacramento River through the fall and winter months. Some winter-run chinook salmon juveniles move downstream to rear in the lower Sacramento River and Delta during the late fall and winter. Smolting and ocean entry typically occurs between January and April.

2. Population Trends - Central Valley Spring-run Chinook Salmon

Historically, spring-run chinook salmon were predominant throughout the Central Valley, occupying the upper and middle reaches of the San Joaquin, American, Yuba, Feather, Sacramento, McCloud, and Pit rivers, with smaller populations in most other tributaries with sufficient habitat for over-summering adults (Stone 1874; Rutter 1904; Clark 1929). The Central Valley drainage as a whole is estimated to have supported spring-run chinook salmon runs as large as 600,000 fish between the late 1880s and 1940s (CDFG 1998). Before the construction of Friant Dam, nearly 50,000 adults were counted in the San Joaquin River (Fry 1961). Following the completion of Friant Dam, the native population from the San Joaquin River and its tributaries was extirpated. Spring-run chinook salmon no longer exist in the American River due to the existence and operation of Folsom Dam.

Natural spawning populations of Central Valley spring-run chinook salmon are currently restricted to accessible reaches in the upper Sacramento River, Antelope Creek, Battle Creek, Beegum Creek, Big Chico Creek, Butte Creek, Clear Creek, Deer Creek, Feather River, Mill Creek, and Yuba River (CDFG 1998; USFWS, unpublished data). With the exception of Butte Creek and the Feather River, these populations are relatively small ranging from a few fish to several hundred. Butte Creek returns in 1998 and 1999 numbered approximately 20,000 and 3,600, respectively (CDFG unpublished data). On the Feather River, significant numbers of spring-run chinook, as identified by run timing, return to the Feather River Hatchery. However, coded-wire-tag information from these hatchery returns indicates substantial introgression has occurred between fall-run and spring-run chinook populations in the Feather River due to hatchery practices.

Additional historical and recent published chinook salmon abundance information are summarized in Myers *et al.* (1998).

B. Steelhead

1. General Life History

Steelhead exhibit perhaps the most complex suite of life history traits of any species of Pacific salmonid. They can be anadromous or freshwater resident. Resident forms are usually called rainbow trout. Winter steelhead generally leave the ocean from August through April, and spawning occurs between December and May (Busby *et al.* 1996). The timing of upstream migration is generally correlated with higher flow events and associated lower water temperatures. Unlike Pacific salmon, steelhead are iteroparous, or capable of spawning more than once before death (Busby *et al* 1996). However, it is rare for steelhead to spawn more than twice before dying; most that do so are females (Busby *et al.* 1996; Nickelson *et al.* 1992). Iteroparity is more common among southern steelhead populations than northern populations (Busby *et al.* 1996).

Steelhead spawn in cool, clear streams featuring suitable gravel size, depth, and current velocity. Intermittent streams may be used for spawning (Barnhart 1986; Everest 1973). The length of the incubation period for steelhead eggs is dependant on water temperature, dissolved oxygen concentration, and substrate composition. In late spring and following yolk sac absorption, alevins emerge from the gravel as fry and begin actively feeding in shallow water along perennial stream banks (Nickelson *et al.* 1992).

Summer rearing takes place primarily in higher velocity areas in pools, although young-of-the-year are also abundant in glides and riffles. Winter rearing occurs more uniformly at lower densities across a wide range of fast and slow habitat types. Productive steelhead habitat is characterized by complexity, primarily in the form of large and small wood. Some older juveniles move downstream to rear in larger tributaries and mainstem rivers (Nickelson *et al.* 1992). Juveniles feed on a wide variety of aquatic and terrestrial insects (Chapman and Bjornn 1969), and emerging fry are sometimes preyed upon by older juveniles. Juveniles live in freshwater from one to four years (usually two years in the California) (Barnhart 1986), then smolt and migrate to the sea from February through April. Although some steelhead smolts may outmigrant during the fall and early winter months.

California steelhead typically reside in marine waters for one to two years prior to returning to their natal stream to spawn as three- or four-year olds (Busby *et al.* 1996).

2. Population Trends - Central Valley steelhead

Central Valley steelhead once ranged throughout most of the tributaries and headwaters of the Sacramento and San Joaquin basins prior to dam construction, water development, and watershed perturbations of the 19th and 20th centuries (McEwan and Jackson 1996; CALFED 2000). In the early 1960s, the California Fish and Wildlife Plan estimated a total run size of about 40,000 adults for the entire Central Valley including San Francisco Bay (CDFG 1965). The annual run size for this ESU in 1991-92 was probably less than 10,000 fish based on dam counts, hatchery returns and past spawning surveys (McEwan and Jackson 1996).

At present, all Central Valley steelhead are considered winter-run steelhead (McEwan and Jackson 1996), although there are indications that summer steelhead were present in the Sacramento River system prior to the commencement of large-scale dam construction in the 1940's (IEP Steelhead Project Work Team 1999). McEwan and Jackson (1996) reported wild steelhead stocks appear to be mostly confined to upper Sacramento River tributaries such as Antelope, Deer, and Mill creeks and the Yuba River. However, naturally spawning populations are also known to occur in Butte Creek, and the upper Sacramento mainstem, Feather, American, Mokelumne, Calaveras and Stanislaus rivers (CALFED 2000, McEwan 2001). It is possible that other naturally spawning populations exist in Central Valley streams, but are undetected due to lack of monitoring and research programs. The recent implementation of new fisheries monitoring efforts has found steelhead in streams previously thought not to contain a population, such as Auburn Ravine, Dry Creek, and the Stanislaus River (IEP Steelhead Project Work Team 1999).

Additional historical and recently published steelhead abundance are summarized in the NMFS west coast steelhead status review (Busby *et al.* 1996) and DFG assessment of current monitoring for Central Valley steelhead (McEwan, D. 2001).

III. Environmental Baseline

A. Geographic Scope and Action Area

The environmental baseline is an analysis of the effects of past and ongoing human and natural factors leading to the current status of the species. The environmental baseline includes the past and present impacts of all federal, state, or private actions and other human activities in the action area (50 CFR §402.02). For the purposes of this Opinion, the action area includes the following: Shasta Dam and the reaches of the Sacramento River downstream of this dam that may be affected by the operation of Reclamation facilities; Whiskeytown Dam and the reaches of Clear Creek downstream of this dam that may be affected by the operation of Reclamation facilities; Oroville Dam and the reaches of the Feather River downstream of this dam that may be affected by the operation of DWR facilities; Folsom Dam and the reaches of the American River downstream of this dam that may be affected by the operation of Reclamation facilities; New Melones Dam and the reaches of the Stanislaus River downstream of this dam that may be affected by the operation of Reclamation facilities.

B. *Central Valley Environmental Baseline*

Profound alterations to the riverine habitat of the Central Valley began with the discovery of gold in the middle of the last century. Dam construction, water diversion, and hydraulic mining soon followed, launching the Central Valley into the era of water manipulation and coincident habitat degradation. A number of documents have addressed the history of human activities, present environmental conditions, and factors contributing to the decline of salmon and steelhead species in the Central Valley. For example, NMFS has prepared range-wide status reviews for west coast chinook (Myers *et al.* 1998) and steelhead (Busby *et al.* 1996). Information is also available in Federal Register notices announcing ESA listing proposals and determinations for some of these species and their critical habitat (June 16, 1993, 58 FR 33212; January 4, 1994, 59 FR 440; March 19, 1998, 63 FR 13347; September 16, 1999, 64 FR 50394; February 16, 2000, 65 FR 7764). The final Programmatic Environmental Impact Statement/Report for the CALFED Bay-Delta Program (July 2000) (CALFED 2000) and the FPEIS for the CVPIA (October 1999) (DOI 1999a) provide an excellent summary of historical and recent environmental conditions for salmon and steelhead in the Central Valley. For the purposes of this document, a general description of the environmental baseline for Sacramento River winter-run chinook salmon, Central Valley spring-run chinook salmon, and Central Valley steelhead is based on a summarization of these documents.

In general, the human activities that have affected listed Central Valley anadromous salmonids and their habitats consist of: (1) dam construction that blocks previously accessible habitat; (2) water development activities that affect the water quantity, timing, and quality; (3) land use activities such as agriculture, flood control, urban development, mining, and logging that degrade aquatic habitat; (4) hatchery operation and practices; (5) harvest activities; and (6) ecosystem restoration actions.

1. Habitat Blockage

Hydropower, flood control, and water supply dams of the CVP, SWP, and other municipal and private entities have permanently blocked or hindered salmonid access to historical spawning and rearing grounds. Clark (1929) estimated that originally there were 6,000 miles of salmon habitat in the Central Valley system and that 80 percent of this habitat had been lost by 1928. Yoshiyama *et al.* (1996) calculated that roughly 2,000 miles of salmon habitat was actually available before dam construction and mining, and concluded that 82 percent is not accessible today. Clark (1929) did not give details about his calculation. Whether Clark's or Yoshiyama's calculation is used, only remnants of their former range remain accessible today in the Central Valley (CDFG 1998).

In general, large dams on every major tributary to the Sacramento River, San Joaquin River, and Delta block salmon and steelhead access to the upper portions of the respective watersheds. On the Sacramento River Keswick Dam blocks passage to historic spawning and rearing habitat in the upper Sacramento, McCloud and Pit rivers. On the Feather River Oroville Dam and associated facilities block passage to the upper Feather River watershed. Nimbus Dam blocks access to most of the American River Basin. On the San Joaquin River, water development projects in the 19th century eliminated fall-run chinook salmon that spawned in the mainstem of the river. Friant Dam construction in mid-1940's has been associated with the elimination of spring-run chinook salmon in the San Joaquin River upstream of the Merced River (DOI 1999a).

2. Water Development Activities

The diversion and storage of natural flows by dams and diversion structures on Central Valley waterways have depleted streamflows and altered the natural cycles by which juvenile and adult salmonids base their migrations. Depleted flows have contributed to higher temperatures, lower dissolved oxygen levels, and decreased recruitment of gravel and large woody debris. In addition, the altered flow regime below several Central Valley dams has impaired the regeneration of riparian vegetation. Historical seasonal flow patterns included high flood flows in the winter and spring with declining flows throughout the summer and early fall. As flows declined during the summer, the seeds from willows and cottonwood trees, deposited on the recently created sand bars, would germinate, sprout, and grow to maturity. The roots of these plants would follow the slowly receding water table, allowing the plants to become firmly established before the next rainy season. With the completion of upstream reservoir storage projects throughout the Central Valley, the seasonal distribution of flows differs substantially from historical patterns. The magnitude and duration of peak flows during the winter and spring are reduced by water impoundment in upstream reservoirs. Instream flows during the summer and early fall months have increased over historic levels for deliveries of municipal and agricultural water supplies. Overall, water management now reduces natural variability by creating more uniform flows year-round that diminish natural channel forming, riparian vegetation, and foodweb functions.

Water diversions for irrigated agriculture, municipal and industrial use, and managed wetlands are found throughout the Central Valley. Hundreds of small and medium size water diversions exist along the Sacramento River, San Joaquin River and their tributaries. Depending on the size, location, and season of operation, these unscreened intakes entrain many life stages of aquatic species, including juvenile salmonids. More than 2,000 unscreened diversions in the Delta entrain resident and anadromous fishes.

3. Land Use Activities

About 150 years ago, the Sacramento River was bordered by up to 500,000 acres of riparian forest, with bands of vegetation literally spreading four to five miles (Resources Agency 1989). By 1979, riparian habitat along the Sacramento River diminished to 11,000-12,000 acres or about 2 percent of historic levels (McGill 1979). More recently, about 16,000 acres of remaining riparian vegetation has been reported (McGill 1987). The degradation and fragmentation of riparian habitat has resulted mainly from flood control and bank protection projects, together with the conversion of riparian land to agriculture (Jones and Stokes Associates 1993).

Increased sedimentation resulting from agricultural and urban practices within the Central Valley is a primary cause of salmonid habitat degradation. Sedimentation can adversely affect salmonids during all freshwater life stages by clogging, or abrading gill surfaces; adhering to eggs; inducing behavioral modifications; burying eggs or alevins; scouring and filling pools and riffles; reducing primary productivity and photosynthetic activity; and affecting intergravel permeability and dissolved oxygen levels. Embedded substrates can reduce the production of juvenile salmonids and hinder the ability of some over-wintering juveniles to hide in the gravels during high flow events.

Land use activities associated with road construction, urban development, logging, mining, agriculture, and recreation have significantly altered fish habitat quantity and quality through alteration of streambank and channel morphology; alteration of ambient stream water temperatures; degradation of water quality; elimination of spawning and rearing habitat; fragmentation of available habitats; elimination of downstream recruitment of gravel and large woody debris; and removal of riparian vegetation resulting in increased streambank erosion. Agricultural practices have eliminated large trees and logs and other woody debris that would have been otherwise recruited to the stream channel. Large woody debris influences stream morphology by affecting pool formation, channel pattern and position, and channel geometry.

Historically in the Sacramento/San Joaquin Delta, tidal marshes provided a highly productive estuarine environment for juvenile anadromous salmonids. During the course of their downstream migration, juvenile winter-run chinook, spring-run chinook, and steelhead utilize the Delta's estuarine habitat for seasonal rearing, and as a migration corridor to the sea. Since the 1850s, reclamation of Delta islands for agricultural purposes caused the cumulative loss of 94 percent of the Delta's tidal marshes (Monroe *et al.* 1992).

In addition to the degradation and loss of estuarine habitat, downstream migrant juvenile salmon in the Delta have been subject to adverse conditions created by water export operations at the CVP/SWP. Specifically, juvenile salmon have been adversely affected by: (1) water diversion from the mainstem Sacramento River into the Central Delta via the manmade Delta Cross Channel; (2) upstream or reverse flows of water in the lower San Joaquin River and southern Delta waterways; and (3) entrainment at the CVP/SWP export facilities and associated problems at Clifton Court Forebay. Juvenile salmonids are exposed to increased water temperatures in the Delta during the late spring and summer due to the loss of riparian shading, and by thermal inputs from municipal, industrial, and agricultural discharges.

4. Hatchery Operation and Practices

Five hatcheries currently produce chinook salmon in the Central Valley and four of these also produce steelhead. Releasing large numbers of hatchery fish can pose a threat to wild chinook and steelhead stocks through genetic impacts, competition for food and other resources between hatchery and wild fish, predation of hatchery fish on wild fish, and increased fishing pressure on wild stocks as a result of hatchery production (Waples 1991). The genetic impacts of artificial propagation programs in the Central Valley are primarily caused by the straying of hatchery fish and the subsequent hybridization of hatchery and wild fish. In the Central Valley, practices such as trucking smolts to distant sites for release and the transferring of eggs between hatcheries contribute to elevated straying levels (DOI 1999a).

5. Harvest

Extensive ocean recreational and commercial troll fisheries for chinook salmon exist along the Central California coast, and an inland recreational fishery exists in the Central Valley for chinook salmon and steelhead. Ocean harvest of Central Valley chinook is estimated using an abundance index, called the Central Valley Index (CVI). The CVI harvest rate is the ratio of salmon harvested south of Point Arena (where 85 percent of Central Valley chinook are caught) to the CVI escapement.

Since 1970, the CVI ocean harvest index for winter-run chinook salmon has generally ranged between 0.50 and 0.80. In 1990 when additional harvest restrictions to protect winter-run chinook were first imposed by the NMFS and Pacific Fisheries Management Council (PFMC), the CVI harvest rate was near the highest level at 0.79. Through the early 1990's, the ocean harvest index was belowthis level: 0.71 in 1991, 0.71 in 1992, 0.72 in 1993, 0.74 in 1994, 0.78 in 1995 and 0.64 in 1996. In 1996 and 1997, NMFS issued biological opinions which concluded that incidental ocean harvest of winter-run chinook represented a significant source of mortality to the endangered population, even though ocean harvest was not a key factor leading to the decline of the population (National Marine Fisheries Service 1996, 1997). As a result of these opinions, measures were developed and implemented by the PFMC, NMFS, and CDFG to reduce ocean harvest impacts by approximately 50 percent.

There are limited data on spring-run chinook ocean harvest rates. An analysis using coded wire tagged (CWT) spring-run from the Feather River Hatchery estimate harvest rates were 18 percent to 22 percent for age-3 fish, 57 percent to 85 percent for age-4 fish, and 97 percent to 100 percent for age-5 fish (CDFG 1998).

Historically, in California, almost half of the river sportfishing effort was in the Sacramento-San Joaquin River system, particularly upstream from the city of Sacramento (Emmett *et al.* 1991). Since 1987, the Fish and Game Commission has adopted increasingly stringent regulations to reduce and virtually eliminate the in-river sport fishery for winter-run chinook. Present regulations include a year-round closure to salmon fishing between Keswick Dam and the Deschutes Road Bridge and a rolling closure to salmon fishing on the Sacramento River between the Deschutes Road Bridge and the Carquinez Bridge. The rolling closure spans the majority of months adult winter-run chinook salmon are ascending the Sacramento River to their spawning grounds. These closures have virtually eliminated impacts on winter-run chinook by recreational angling in freshwater.

To address potential incidental take of chinook salmon that occurs in the recreational trout fishery, the California Fish and Game Commission adopted in 1992 gear restrictions (all hooks must be barbless and a maximum 2.25 inches in length) to minimize hooking injury and mortality caused by trout anglers incidentally catching winter-run chinook. That same year, the Commission also adopted regulations which prohibited any salmon from being removed from the water to further reduce the potential for injury and mortality to winter-run chinook from the trout and steelhead fishery.

Specific regulations for the protection of spring-run chinook salmon in Mill, Deer, Big Chico, and Butte creeks were added to the existing CDFG regulations in 1994. Existing regulations, including those developed for winter-run chinook provide some level of protection for Central Valley spring-run chinook (CDFG 1998).

There is little information on steelhead harvest rates in California. Hallock *et al.* (1961) estimated that harvest rates for Sacramento River steelhead from the 1953-54 through 1958-59 seasons ranges from 25.1 percent to 45.6 percent assuming a 20 percent non return rate of tags. Staley (1976) estimated the harvest rate in the American River during the 1971-72 and 1973-74 seasons to be 27 percent. The average annual harvest rate on adult steelhead above Red Bluff Diversion Dam for the three year period 1991-92 through 1993-94 is 16 percent (McEwan and Jackson 1996).

6. Ecosystem Restoration

Preliminary, significant steps towards the largest ecological restoration project yet undertaken in the United States have occurred during the past four years and continue to proceed in California's Central Valley. The CALFED Program, in coordination with other Central Valley efforts including the CVPIA, has implemented numerous habitat restoration actions that benefit Sacramento River winter-run chinook, Central Valley steelhead, Central Valley spring-run chinook salmon, and their critical habitat. These restoration actions include the installation of fish screens, modification of barriers to improve fish passage, and habitat acquisition and restoration. The majority of these recent restoration actions address key factors for decline of these ESUs and emphasis has been placed in tributary drainages with high potential for steelhead and spring-run chinook production. Additional actions that are currently underway that benefit winter-run chinook salmon, Central Valley steelhead and Central Valley spring-run chinook include new efforts to enhance fisheries monitoring and conservation actions to address artificial propagation. In the Delta, approximately 1,500 acres of land have been purchased for restoration activities since 1996. Restoration of these Delta areas primarily involves flooding lands previously used for agriculture, thereby creating additional wetland areas and rearing habitat for juvenile salmonids.

A beneficial action unrelated to the CALFED Program and the CVPIA includes the Environmental Protection Agency's remedial actions at Iron Mountain Mine. The completion of a state-of-the-art lime neutralization plant is successfully removing significant concentrations of toxic metals in acidic mine drainage from the Spring Creek Watershed. Containment loading into the upper Sacramento River from Iron Mountain Mine has shown measurable reductions since the early 1990's.

HI. EFFECTS OF THE ACTION

For purposes of this Opinion, the February 15, 2001 50% and 90% exceedance forecasts are used to assess the impacts to listed species covered under this opinion. Water Year 2001 SWP/CVP Operations Plan and forecasts include the implementation of EWA and CVPIA (b)(2). Also, the temperatures predicted for 2001 are based on January through December 2001 forecasts. Both the flow and temperature forecasts are based on monthly models, except for American River temperatures which are based on weekly averages, therefore, daily flow release and daily temperatures can fluctuate from the monthly values.

Clear Creek

Adult Migration. Spawning, and Incubation

From February, 2001, through January 2002, Reclamation proposes to release 200 cfs from Whiskeytown Reservoir to Clear Creek except for the summer months (June through September) when releases would be 150 cfs under both forecasts. Under the 90% exceedence forecast, Reclamation proposes to release 200 cfs March through May and 150 cfs June through January. Summer time releases may be reduced to 50 cfs in the 90% forecast, if CVPIA (b)(2) water allocation is reduced.

This release schedule is consistent with the AFRP flow targets for Clear Creek, unless releases drop below 150 cfs, currently Clear Creek is at 125 cfs. The AFRP flow targets are within the average total annual unimpaired flows to the Clear Creek watershed. In light of the McCormick Saeltzer Dam being removed in November 2000, a Fishery Management Plan for Clear Creek is currently being developed in coordination with CDFG, USFWS and NMFS that will recommend a new release schedule based on the temperature requirements of spring-run chinook and steelhead. Predicted monthly average temperatures at the mouth of Clear Creek under both exceedance forecasts would range from 42 °F to 52 °F during the fall/winter period and 52°F to 63°F during the summer (June-September) period. Temperatures upstream of the mouth in Clear Creek are predicted to be slightly cooler.

Steelhead adults will be migrating upstream from the Sacramento River into Clear Creek during December through March to spawn. Spawning and rearing habitat for steelhead and spring-run chinook salmon will increase up to the base of Whiskeytown Dam due to the removal of McCormick Saeltzer Dam. Based on observations in the Sacramento River, steelhead spawning typically occurs from December through April with peak activity occurring from January through March (Hallock et al. 1961, as cited in McEwan and Jackson 1996). Flows in Clear Creek ranging from 150 to 200 cfs are expected to provide adequate depths and velocities for upstream passage of steelhead adults and predicted temperature conditions are within the range of preferred spawning temperatures.

Egg incubation to emergence of steelhead fry can take as little as eight to ten weeks to occur after fertilization depending on redd depth, gravel size, siltation, and temperature (Leitritz and Lewis

1980, Shapovalov and Taft 1954, as cited in McEwan and Jackson 1996). Accordingly, emergence may occur anytime from approximately mid-February through May. Predicted monthly average temperatures at the mouth of Clear Creek are below the range of preferred incubating and emergence temperatures (48°F to 52°F) from December through May. Cooler temperatures during these months are likely to slow the development of incubating eggs and pre-emergent fry resulting in a longer incubation period. For spring-run chinook salmon, spawning primarily occurred during September and emergence of fry from redds is predicted for December and January based on predicted temperatures.

During December through March, large flow releases from Whiskeytown Dam to Clear Creek may be required for short durations by Reclamation for flood control and safety of dams criteria. For example, flows on February 6, 1999, increased from 240 cfs to 2,900 cfs within 24 hours and then dropped back to 520 cfs within the next 48 hours. In addition large flow releases (1,200 cfs/day) are being planned to remove sediment and reform the channel above McCormick Saeltzer Dam. Short duration, high flow events of this nature have the potential to scour steelhead redds and result in the injury and mortality of steelhead eggs and sac-fry. These adverse effects may occur to spring-run chinook salmon during December and January as well.

Snorkel surveys conducted by FWS and DFG during the summer of 1999, identified 35+ adult chinook salmon in Clear Creek between Whiskeytown Dam and the confluence with the Sacramento River. All but one of these fish were observed below McCormick-Saeltzer Dam. One adult female chinook was observed 1.6 miles upstream of McCormick-Saeltzer Dam on August 19, 1999. Two of the adult chinook from 1999 were recovered with CWT's, one was a Feather River fall-run and the other a Feather River spring run. After removal of McCormick-Saeltzer Dam in November 2000, snorkel surveys identified 17 adult chinook salmon above the former dam site, of these 9 were killed before spawning due to poaching or predators (pers. com Matt Brown 2001).

Phenotypic indicators suggest most, if not all, of the adult chinook salmon observed in Clear Creek during the 1999 surveys are spring-run chinook salmon. These fish began spawning in September 1999, and emergence of fry is expected during December and January. Relatively stable releases from Whiskeytown Dam during the period of September through November provided flow conditions which avoided scouring and dewatering of redds. On September 7, 1999, and again on September 10, 1999, Reclamation increased flows in Clear Creek in 50 cfs increments to improve temperature conditions for spawning and incubating spring-run chinook. Water temperatures generally dropped by 1 °F in lower Clear Creek within 48 hours in response to each flow increase. Reclamation's temperature control efforts in September 1999, avoided significant losses of spring-run chinook eggs and fry below McCormick-Saeltzer Dam. However, the resulting temperatures of 57°F to 60°F during September may have reduced the survival of some eggs and pre-emergent spring-run chinook in Clear Creek.

Fry, Juveniles, and Smolts

For fry and juvenile steelhead and spring-run chinook, water temperatures between 45°F and 60°F for steelhead and between 50°F to 60°F for spring-run chinook are preferred for growth and development. Predicted monthly average temperatures in Clear Creek from January through December are either slightly below or within the preferred temperature range for steelhead and are below preferred temperatures for spring-run chinook. Water temperatures are forecasted to exceed the preferred range by 2-3°F at the mouth during July and August.

Predictive Temperature Model

The predictive temperature model for Clear Creek uses average ambient air temperatures as part of the input data set to produce monthly water temperatures. In the event that ambient air temperatures exceed the average conditions, warming of Whiskeytown releases during passage downstream could be underestimated. A temperature study conducted on Clear Creek during the summer of 1998 (USFWS unpublished data) found that release temperatures at Whiskeytown Dam used in the temperature modeling forecasts were almost five degrees cooler then the actual release temperatures. Consequently, the temperature modeling provided in the November 2000 BA may significantly underestimate temperatures within Clear Creek in the summer months. In addition the use of average monthly temperatures does not account for the trend or magnitude of temperature fluctuations over the course of a month which may underestimate potential daily adverse effects.

Reclamation did not propose any ramping criteria for Whiskeytown releases to Clear Creek. As presented in the example above, flows in Clear Creek may increase and decrease rapidly in response to Whiskeytown Reservoir flood control or safety of dams criteria. Isolation of juvenile steelhead and spring-run chinook may occur in areas that are not connected to the creek except during periods of high flows. Juvenile salmon have been observed in pools and side channels adjacent to Clear Creek when flows were decreased from 200 cfs in May to 50 cfs in June (Matt Brown, USFWS, personal communication 1999). If no additional high flow events follow within a short period of time, these fish may be lost to predation, lethal water temperature conditions, or dessication.

Based on emigration patterns of steelhead in the upper Sacramento River, steelhead juveniles and smolts may emigrate downstream and out of Clear Creek from October through early July (McEwan and Jackson, 1996; SWRI 1997, as cited in DWR and Reclamation 2000). Predicted flows in Clear Creek are expected to provide suitable depths and velocities for juvenile steelhead rearing and emigration from October through May. Predicted water temperatures in Clear Creek are expected to be within, or below, preferred temperatures for juvenile steelhead rearing and emigration between December 2001 and January 2002. In the likely scenario that CVPIA (b)(2) water is not available in 2001 because of the critically dry forecast, flows will be decreased to 50 cfs from June through September and water temperatures (not modeled to date) would be above the preferred range for juvenile steelhead.

Spring-run chinook salmon juveniles in the Sacramento River Basin exhibit two different life history strategies. Most juveniles enter saltwater as sub-yearlings and are typically migrating downstream 60-150 days post-hatching during the spring. Other juveniles remain in freshwater through the spring and summer months and emigrate the following fall as yearlings. Emigration of yearling spring-run chinook juveniles from the upper Sacramento River and its tributaries typically occurs October through March, with peak movement in November and December (DFG 1998). In Clear Creek, both juvenile life history strategies may be represented. Predicted flows in Clear Creek are expected to provide suitable depths and velocities for juvenile spring-run chinook rearing and emigration between December and March. Predicted water temperatures in Clear Creek are expected to be within, or below, preferred temperatures for juvenile spring-run chinook rearing and emigration between December and March.

Current abundance estimates for steelhead within the lower Clear Creek are unknown. However, it is anticipated that any rearing juvenile steelhead may be exposed to stressful temperatures and flow fluctuations during June through September. In the worst case (90%exceedance forecast) the stress can be potentially lethal through increased susceptibility to disease, predation, and/or other mortality factors (Reiser and Bjornn 1979; Boles et al. 1988) or through isolation.

Sacramento River

Adult Migration. Spawning, and Incubation

In water year 2001 (90% exceedence forecast) Reclamation proposes to release the minimum flow 3250 cfs from Keswick Dam to the upper Sacramento River January through March and November through January 2002 . In the 90% forecast the minimum 1.9 MAF carryover as specified in the WRO for Shasta end-of-September storage is not met. In the 50% exceedence forecast, Reclamation proposes to release 3500 cfs in March, 7200 cfs in April, 5300 cfs in October, 4282 cfs November, and minimum flows December through January 2002.. Actual daily releases may fluctuate from these monthly averages, particularly during flood control operations. Minimum releases from Keswick Dam will not drop below 3,250 cfs. Both forecasts have high flows in the 10,000 to 14,000 cfs range during the summer months consistent with the AFRP flow targets for the upper Sacramento River. Predicted monthly average temperatures between Keswick Dam and Red Bluff during the period of January through December 2001, generally range from 46 °F to 57°F under both exceedence forecasts.

Steelhead adults migrate upstream in the Sacramento River during all months except during April, May and June when they typically return downstream to the ocean. Specific information regarding steelhead spawning within the Sacramento River is limited. However, adult steelhead in the Sacramento River Basin are expected to typically spawn from December through April with peak activity occurring from January through March (Hallock et al. 1961, as cited in McEwan and Jackson 1996). Keswick Dam releases of 3,250 to 7,000 cfs combined with tributary accretions are expected to provide adequate depths and velocities for upstream passage of migrating adults and for spawning. Predicted average monthly temperatures are within the range of preferred spawning temperatures for steelhead.

The extent of spring-run chinook spawning in the mainstem of the upper Sacramento River is unknown. Spring-run chinook are thought to move above RBDD towards Keswick Dam as they seek cooler water within the suitable temperature range for spawning (<56°F). Spring-run chinook adults in the upper Sacramento River spawned primarily in September 2000, and emergence of fry is expected during December and January. Relatively stable releases from Keswick Dam during the period of September through November 2000, provided flow conditions which avoided scouring and dewatering of redds. However, spring-run chinook attempting to spawn in the mainstem or tributaries above RBDD have experienced delayed passage upstream at RBDD when the gates are in place July through August. These spawners have trouble finding the ladders at RBDD because of the high flows being released from Keswick Dam at that time. Delays to upsteam migration at RBDD can mean that some tributaries upstream will be blocked due to thermal barriers and low flows that develop by late summer.

Daily average water temperatures in the upper Sacramento mainstem between Keswick and Bend Bridge were generally below 56°F and, thus, within the preferred range for spring-run chinook salmon spawning and incubation. Predicted monthly average temperatures in the upper Sacramento River are generally below or within the range of suitable incubating and emergence temperatures (48°F to 52°F) from December through March. Cooler temperatures during these months are likely to slow the development of incubating eggs and pre-emergent fry resulting in a longer incubation period. For spring-run chinook salmon, spawning primarily occurred during September and emergence of fry from redds is predicted for December and January.

During the period of steelhead egg and larval incubation (includes December through May), some large flow releases from Shasta and Keswick dams to the upper Sacramento River may be required for flood control and safety of dams criteria. Extremely high flow events have the potential to scour steelhead redds and result in the injury and mortality of steelhead eggs and sac-fry. Redds constructed during high flow releases may be dewatered when releases return to the projected forecast schedule. However, most releases made from Shasta Dam to avoid encroachment into the reservoir flood pool are not expected to scour or damage steelhead redds. The extent of redds lost or damaged by dewatering is expected to be minimal under most circumstances unless very high flows are sustained for several weeks followed by the minimum release of 3,250 cfs. Adverse effects may occur to spring-run chinook sac-fry during December and January as well.

Fry, Juveniles, and Smolts

For fry and juvenile steelhead and spring-run chinook, water temperatures between 45°F and 60°F for steelhead and between 50°F to 60°F for spring-run chinook are preferred for growth and development. Predicted monthly average temperatures in the mainstem Sacramento River from December through January are within the preferred temperature range for rearing steelhead and are either slightly below or within preferred temperatures for rearing spring-run chinook.

The ramping criteria for Keswick Dam releases to the Sacramento River established in the WR Opinion remains in effect through March 31. This ramping criteria is expected to minimize or eliminate impacts to steelhead and spring-run chinook fry and juveniles from stranding and dewatering. Ramping down of flows occurs primarily at night when fish are typically more active and less likely to become isolated in pools or side channels. In addition, releases are reduced at very slow rates over several nights allowing adequate opportunities for fish to pass from shallow nearshore areas and pools into the mainstem of the river.

Steelhead juveniles and smolts may emigrate from the upper Sacramento River over a prolonged period (October through early July) (McEwan and Jackson, 1996; SWRI 1997, as cited in DWR and Reclamation 2000). Spring-run yearlings may emigrate from the upper Sacramento beginning in October and extend through February while sub-yearlings may begin in December and continue through May. Predicted monthly average temperatures in the upper Sacramento River are within the preferred smoltification temperatures for juvenile steelhead and spring-run chinook salmon from November through June. Also, predicted flows within the upper Sacramento River are expected to provide suitable depths and velocities for emigrating juvenile steelhead and spring-run chinook salmon.

A substantial resident rainbow trout population predominates in the upper Sacramento River above Red Bluff due to the dependable cool summer flows out of Keswick Dam. It is not known at this time what the effect of this resident population might have on anadromous steelhead. New information suggests that resident rainbow trout have a selective advantage in upstream areas close to dams while steelhead have an advantage in areas further downstream where summer growth is poor (Cramer 2000).

American River

Adult Migration. Spawning, and Incubation

From February 2001, through January 2002, Reclamation proposes to release on average 1500 to 3,300 cfs from Nimbus Dam to the American River under the 50% exceedence forecast and 830 to 2,100 cfs under the 90% exceedence forecast. Actual daily releases may fluctuate from these monthly averages, particularly during flood control operations. This flow schedule is consistent with the AFRP flow targets for the lower American River (LAR). However, low flow releases in February of 2001 have adversely affected spawning steelhead by exposing their redds to trampling from anglers and by leaving adults vulnerable to snagging. Flow releases below 1500 cfs forecasted for March 2001 may adversely affect steelhead eggs that were spawned earlier in December and January at 2500 cfs.

Predicted water temperature forecasts for water year 2001 using weekly averages in the new Cold-Water Pool Management Model(CPMM) predicted lethal summer time temperatures for steelhead (69°F to 77°F) in the 90% alternatives and 65°F to 67°F upper summer time limits in the 50% alternatives. Water temperatures modeled included the area from Nimbus Dam down to the Watt Avenue Bridge for the following five alternatives:

1) 50% Forecast-Unconstrained Operation
2) 50% Forecast- Summer Shutter Operation for Steelhead
3) 90% Forecast- Unconstrained
4) 90% Forecast-Summer Shutter Operation for Steelhead
5) 90% Forecast- Fall Shutter Operation for Salmonids

Forecast Alternatives 1 and 3 represent a schedule of reasonably achievable LAR water temperatures assuming releases are not constrained by either Folsom Dam or penstock operation. Blending of water temperatures and shutter operations are optimized to meet the target of 65°F downstream to Watt Avenue. Alternatives 2 and 4 assume shutter operations (without blending) would begin in the summer to benefit steelhead and that a sufficient cold-water pool is available for fall-run chinook salmon. Alternative 5 assumes shutters are only operated in the fall to benefit fall-run chinook salmon under current shutter and penstock constraints (no blending).

Adult steelhead migration typically occurs in the American River from November through April, and peaks from December through March (McEwan and Jackson, 1996; SWRI 1997, as cited in DWR and Reclamation 2000). Predicted weekly average temperatures in the lower American River are within the range of preferred migrating temperatures (46 °F to 52 °F) from December through March in the 50% Forecast Alternatives and above the preferred range in the 90% Forecast Alternatives. Forecasted flow conditions are expected to provide suitable depths and velocities for upstream passage of adults to spawning areas within the lower American River.

Steelhead spawning in the American River typically occurs from December through April (McEwan and Jackson, 1996; SWRI 1997, as cited in DWR and Reclamation 2000). Predicted weekly average temperature from Nimbus Dam to Watt Avenue are within the range of preferred spawning temperatures from December through March in the 50% forecasts. Egg incubation to emergence of steelhead fry includes the period from December through April. Predicted weekly average temperatures within the lower American River exceed the range of preferred incubating and emergence temperatures (48 °F to 52 °F) in December and March in all the alternatives modeled except for Alternative 2.. Cooler temperatures during these months are likely to slow the development of incubating eggs and pre-emergent fry resulting in a longer time until emergence.

During the period of steelhead egg and larval incubation (includes December through April), large flow releases from Folsom and Nimbus dams to the lower American River may be required by Reclamation for flood control and safety of dams criteria. Extremely high flow events have the potential to scour steelhead redds and result in the injury and mortality of steelhead eggs and sac-fry. Use of a proposed "Modified Rule Curve" for the enlargement of the Folsom Dam outlets would limit flood releases to 60% of inflows and provide some measure of protection against scouring below Nimbus Dam as well as providing a slight temperature benefit (Corps 2001). Most releases from Folsom Dam to avoid encroachment into the reservoir flood pool will not create high velocity, scouring flow conditions in the Lower American River that are likely to damage steelhead redds. However, redds constructed during high flow releases may be dewatered when releases return to the projected forecast schedule. The extent of steelhead redds lost or damaged by dewatering is not easily quantified, but rapid and large flow fluctuations are known to expose steelhead and chinook redds in the early winter months (DFG 1993).

Spring-run chinook salmon historically occurred in the South, North and Middle forks of the American River (DFG 1998). Following years of ineffective or absent fish ladders at the historic Folsom Dam, upstream access was completely blocked when the new, present-day Folsom and Nimbus dams were constructed. Due to the absence of cold water pools in the lower American River for over-summering, spring-run chinook no longer exist in the American River.

Fry, Juveniles, and Smolts

For fry and juvenile steelhead, water temperatures between 45 °F and 65 °F are preferred for growth and development. Predicted weekly average temperatures in the lower American River are within the preferred temperature range for the 50% forecast (Alternatives 1 and 2) but are above the lethal limits for juvenile steelhead in the 90% forecast (Alternatives 3, 4 and 5).

Reclamation proposes to use draft ramping criteria developed by members of the American River Operations Group(AROG) to reduce the incidence of stranding relative to past operations. Reclamation also proposes to continue providing funds for an ongoing 1998 stranding study conducted by DFG to better define criteria for fluctuating flows. Preliminary results of DFG's fish stranding study for the Lower American River indicate that the aquatic habitat most affected by changes in flow below 4,000 cfs tends to be low profile banks and mid-channel bars. A few isolated ponds may be created on these low profile banks and mid-channel bars by reductions in flow from 4,000 cfs to 1,750 cfs. Low profile bars are sensitive to small decreases in stage that can de-water or partially de-water the slopes of the bars. Steelhead fry present along low profile gravel bars or in side channels/pools will generally avoid stranding with the current ramping criteria, but a minimal amount of stranding is expected. Juvenile steelhead, given their size and swimming ability, are expected to have adequate opportunity with the slow ramping rate to leave the affected area in advance of stranding. However, some releases for flood control can not adhere to the draft ramping criteria and streamflows below Nimbus Dam can fluctuate widely during flood control operations. Flow fluctuations currently implemented during flood control operations by the Reclamation may adversely affect fry and juvenile steelhead through stranding on higher terraces and in side channels.

For juvenile steelhead rearing, water temperatures between 45 °F and 65 °F are preferred for growth and development. Predicted weekly average temperatures are not likely to adversely affect rearing and emigrating juvenile steelhead in the 50% forecasts (Alternatives 1 and 2), but will adversely affect steelhead in the 90% forecast (Alternatives 3, 4 and 5). Several years of juvenile salmonid emigration studies in the lower American River indicate large numbers of steelhead fry move downstream from March through June while steelhead yearlings and smolts emigrate from late December through February (Snider et al. 1997, Snider et al. 1998). Predicted flows are expected to provide suitable depth and velocity conditions for emigration. Predicted monthly average temperatures at the mouth of the American River from December through May are within the range of favored steelhead smoltification temperatures.

Stanislaus **River**

Adult Migration, Spawning, and Incubation

From February 2001, through January 2002, Reclamation proposes to release on average 243 to 1,500 cfs from New Melones Reservoir to the Stanislaus River under the 50% exceedence forecast and approximately 243 to 870 cfs under the 90% exceedence forecast. Actual daily releases may fluctuate from these monthly averages, particularly during flood control operations. Minimum releases from New Melones will reduce flows in the lower Stanislaus River below 300 cfs. Predicted monthly average temperatures between Goodwin Dam and the confluence with the San Joaquin River during the period January through December 2001, generally range between 45 °F to 70 °F under both exceedence forecasts.

Steelhead adults migrate upstream in the San Joaquin River during the period between January and June to spawn and are likely to enter into the Stanislaus River during the same period. Under the 50% and 90% exceedence forecasts, predicted monthly average temperatures during the months of January through April, between the mouth of the Stanislaus River and Goodwin Dam (RM 58.5), are generally within the range of preferred migrating temperatures for steelhead (46 °F to 52 °F). New Melones releases *of 243* cfs and greater are expected to provide adequate depths and velocities for upstream passage of migrating adults.

Specific information regarding steelhead spawning within the Stanislaus River is lacking. Based on observations of fall-run chinook spawning and available habitat, steelhead spawning in the Stanislaus River may occur in the reach between Oakdale (RM 41.2) and Goodwin Dam (RM 58.5). Spawning is likely to occur from February through June with peak activity from March through April. Predicted monthly average temperatures between Oakdale and Goodwin Dam are within the range of preferred spawning temperatures (39 °F to 52 °F) during this time. New Melones releases of 243 to 350 cfs are expected to provide adequate depths and velocities for steelhead spawning and incubation. If flows drop to 243 cfs during March, as proposed in the 90% percent exceedence forecast, water depths and velocities at some steelhead redds may be reduced. Provided daily flows do not drop below 243 cfs, incubating steelhead eggs and larvae are not likely to be adversely affected. However, suitable habitat areas for actively spawning steelhead will be limited during March with a flow release of 243 cfs.

During the period of steelhead egg and larval incubation (January through May), large flow releases from New Melones Reservoir to the lower Stanislaus River may be required for flood control and safety of dams criteria. Extremely high flow events have the potential to scour steelhead redds and result in the injury and mortality of steelhead eggs and sac-fry. However, most releases from New Melones Dam to avoid encroachment into the reservoir flood pool are not expected to scour or damage steelhead redds. Redds constructed during high flow releases may be dewatered when releases return to the projected forecast schedule. The amount of redds lost or damaged by dewatering is expected to be minimal under most circumstances unless very high flows are sustained for several weeks followed by the minimum release *of 270 cfs* (243 cfs in March 2001 in the 90% exceedence forecast).

Spring-run chinook salmon may have historically ascended the North and Middle forks of the Stanislaus River (DFG 1998). However, spring-run chinook no longer exist in the Stanislaus River due to impassable dams blocking access to historical spawning reaches.

Fry, Juveniles, and Smolts

For fry and juvenile steelhead, water temperatures between 45°F and 60°F are preferred for growth and development. Predicted monthly average temperatures in the lower Stanislaus River from October through May are generally within the preferred temperature range for steelhead. However, from June through September, predicted water temperatures range from 55°F to in excess of 70 °F. These predicted temperatures for the summer of 2001 are within the range of chronic low stress temperatures that may cause adverse effects to juvenile steelhead. Thermal stress induces varying degrees of physiological responses that may result in an increased susceptibility to disease, predation, and/or other secondary mortality factors (Reiser and Bjornn 1979; Boles et al. 1988). Also, rising temperatures may create additional habitat for warm water predator species within the Stanislaus River and/or increase their metabolic requirements resulting in increased potential predation rates.

In the absence of data regarding ramping of steamflows on the Stanislaus River, FWS has proposed to use ramping criteria developed for the Trinity River for New Melones Dam releases to the lower Stanislaus River because channel characteristics and hydrology are similar. However, this ramping criteria can not be achieved under most flood control operations. Whenever possible, New Melones reservoir is maintained at or near the storage level of its flood control space. When the reservoir is at this elevation and a storm event occurs, additional flows must be released or spilled from New Melones Reservoir through Goodwin Dam into the lower Stanislaus River. Flows can increase significantly in a matter of hours. Once the threat of encroachment to the flood pool is over, flows are reduced to pre-flood releases as soon as possible. Depending on the magnitude and/or duration of these flow fluctuations, there is a potential for fry and juvenile steelhead to become stranded.

Emigration of smolts in the Stanislaus River has been observed from April through June (Cramer 1998, McEwan 2001), but is likely to occur during October through March as well depending on streamflow and temperature conditions. The preferred temperatures for smoltification are less than 57°F (McEwan and Jackson 1996) and water temperatures in excess of 55 °F inhibit formation and decrease activity of gill (Na and K) ATPase activity in steelhead, with concomitant reductions in migratory behavior and seawater survival (Zaugg and Wagner 1973, Adams et. al 1975). Predicted monthly average temperatures are within the preferred smoltification temperatures for juveniles from October through April. From May through September, predicted water temperatures will significantly exceed the preferred temperature range for smoltification. Steelhead are not expected to migrate as smolts when the predicted water temperatures exceed 60°F from May through September. Water temperatures in excess of 55°F inhibit formation and decrease activity of gill (Na and K) ATPase activity in steelhead, with concomitant reductions in migratory behavior and seawater survival (Zaugg and Wagner 1973, Adams et. al 1975). Steelhead that have not emigrated downstream to the Delta and ocean prior to this rise in water temperature during May and June are expected to take up residence in the Stanislaus River. The effects associated with this behavior and delay in emigration to the ocean are also unknown. Although predicted flows within the lower Stanislaus River are very low during the winter and spring months, minimum required depths and velocities for smolt emigration are expected to occur.

The proposed fisheries monitoring program by screw trap in the Stanislaus River is expected to capture few juvenile steelhead. Based on past sampling by screw trap at the Oakdale sampling site, approximately 20 to 30 steelhead smolts and pre-smolts may be captured, measured, rated for smolting characteristics, and released below the trapping site. Steelhead fry have not been captured in previous years and few, if any, are expected to be captured in the winter 2001 and 2002 sampling season. Capture and handling related stress will be minimized by the following procedures: (1) traps will be checked at 12-hour intervals during periods of low debris load and at 6-hour intervals during periods of moderate debris loads; (2) sampling will be suspended by raising the screw trap (non-fishing) during periods of high debris loads; (3) all measured fish will be anesthetized in MS-222; (4) captured fish will be released at different locations each day from immediately behind the trap to 100 yards downstream; and (5) following recovery in a bucket of freshwater, fish will be released within 5-30 minutes of sampling by slowly submerging the holding container underwater. Previous sampling experience with screw traps in the Stanislaus River indicates that all captured steelhead will be maintained in good physical condition and released unharmed back into the river. Although, the Stanislaus River steelhead population is probably low, the expected capture of 20 to 30 juvenile steelhead is expected to have little, if any effect, on the Stanislaus River population due to the low numbers captured and adherence to sampling/handling protocols that minimize stress and harm.

Feather River

Adult Migration. Spawning, and Incubation

From February 2001, through January 2002, DWR proposes to release on average 1,050 to 6,569 cfs from Oroville Dam to the Feather River under the 50% exceedence forecast and 813 to 2,000 cfs under the 90% exceedence forecast. Approximately 600 cfs of this release will pass through the Thermalito Diversion Dam Powerplant into the low flow section of the Feather River. The low flow section is approximately 8 miles long and extends from the Fish Barrier Dam downstream to the Thermalito Afterbay Outlet. The remainder of the release to the river will pass through Thermalito Forebay and Afterbay to be released at the Thermalito Afterbay Outlet. Actual daily releases may fluctuate from these monthly averages, particularly during flood control operations. Minimum releases in the Feather River below the Thermalito Afterbay Outlet may drop below the 1,700 cfs minimum flow established in the August 1983 agreement between DWR and DFG "Concerning the Operation of the Oroville Division of the State Water Project for Management of Fish & Wildlife".

Steelhead adults migrate upstream in the Sacramento River during the period between December and March to spawn and are likely to enter into the Feather River during the same period. Most steelhead return to the Feather River Fish Hatchery and very limited information exists regarding the location, timing and magnitude of steelhead spawning within the river. Observations to date suggest the low flow channel is the primary reach for steelhead spawning (DWR and Reclamation 2000). However, the 14-mile section between the Thermalito Afterbay Outlet and the mouth of Honcut Creek (referred to as the high flow section) supports considerable numbers of fall-run chinook salmon spawners and could support some steelhead spawning. Peak spawning is likely to occur from January through March as it does elsewhere in the Sacramento Basin. Due to the low number of steelhead spawning outside of the Feather River Hatchery, flows of 600 cfs in the low flow channel are expected to generally provide adequate depths and velocities for upstream passage of migrating adults and for spawning. However, the proposed flow regime of a constant 600 cfs in the low flow channel probably restricts normal stream channel forming processes and the development of well-vegetated side channel areas that provide valuable steelhead spawning habitat. Predicted average monthly temperatures within the low flow channel are generally within preferred spawning temperature range for steelhead during the steelhead spawning season. For the steelhead incubation and emergence period, predicted monthly average temperatures are generally within a suitable range in the low flow channel through early June 2001.

Based on observations of spring-run chinook salmon immigration in the Sacramento River, spring-run adults are likely to migrate upstream during the period between March and July into the Feather River where they hold in deep cold water pools until spawning begins in mid- to late August. Most pre-spawning spring-run chinook salmon adults hold in the upper three miles of the low flow channel (DWR and Reclamation 2000). Predicted cooler temperatures near the upper end of the low flow channel during the summer 2001, are likely to provide suitable holding conditions throughout the summer months and provide the coldest water available during September for the initiation of spawning. For spring-run chinook salmon, spawning primarily occurs during September and emergence of fry from redds is predicted for December and January. Stable releases of 600 cfs within the low flow channel during the incubation period of September through November 2001, will likely provide flow conditions which avoid the scouring and dewatering of redds.

During the period of steelhead egg and larval incubation (includes December through March), large flow releases from Oroville Dam to the low flow channel of the Feather River may be required for flood control and safety of dams criteria; Oroville Dam releases in excess of 17,000 cfs must be released to the low flow channel because the powerplants associated with the Thermalito Complex have a capacity of approximately 17,000 cfs. High flow events in the low flow channel have the potential to scour steelhead redds and result in the injury and mortality of steelhead eggs and sac-fry. These adverse effects may also occur to incubating spring-run chinook salmon during December and January. Frequently, flood releases from Oroville Dam can be managed at rates below 17,000 cfs and significant flow increases in the low flow channel can be avoided. Downstream of the Thermalito Afterbay Outlet, steelhead redds constructed during high flow releases may be dewatered when releases return to the projected forecast schedule. The extent of redds lost or damaged by dewatering below Thermalito is expected to be minimal under most circumstances, because the majority of steelhead are thought to spawn in the low flow channel.

Fry, Juveniles, and Smolts

For fry and juvenile steelhead and spring-run chinook, water temperatures between 45°F and 60°F are preferred for growth and development. Predicted monthly average temperatures in the mainstem Feather River are predicted to exceed the preferred temperature range for both species during the period between April and September 2001. Predicted temperatures are within the range of chronic low stress temperatures that may cause adverse effects to juvenile steelhead and spring-run chinook. Thermal stress induces varying degrees of physiological responses that may result in an increased susceptibility to disease, predation, and/or other secondary mortality factors (Reiser and Bjornn 1979; Boles et al. 1988). Also, rising temperatures may create additional habitat for warm water predator species within the Feather River and/or increase their metabolic requirements resulting in increased potential predation rates.

Ramping criteria for the Feather River were established by a 1983 agreement between DWR and DFG. This agreement requires flows below Thermalito Afterbay that are under 2,500 cfs to be reduced by no more than 200 cfs during any 24-hour period, except for flood control, failures, etc. This ramping criteria is expected to minimize or eliminate impacts to steelhead and spring-run chinook fry and juveniles from stranding in areas below the Thermalito Afterbay, Flood control operations may result in rapid and large flow fluctuations within the low flow channel and the river below the Afterbay Outlet. Depending on the magnitude and/or duration of these flow fluctuations, there is a potential for fry and juvenile steelhead to become stranded. Flow fluctuations for flood control operations in the past have resulted in the stranding of juvenile salmon in broad shallow pools on the floodplain near Nelson Slough (CALFED ERP vol. 2, 1999) and potentially in the Robinson gravel pit.

Chinook salmon emigration studies in the Feather River from 1995 through 2000 have incidentally captured steelhead young-of-year and yearlings. Young-of-year were captured from March through June, while yearlings were captured January through June. Steelhead were not captured during the period between October and December, but researchers speculated that the sampling gear may not be able to detect their presence during this time rather than their apparent absence (DWR 1999a, DWR 1999b, DWR 1999c, DWR 2000). Based on these results and steelhead emigration patterns in the Sacramento River, steelhead juveniles and smolts are expected to emigrate from the Feather River to the lower Sacramento River and Delta from December through May. Rotary screw trap data from the 1999/2000 season showed most juvenile steelhead emigrate below Thermalito Afterbay from March through April (DWR 2000 unpublished). Predicted flows in the Feather River are expected to provide adequate depths and velocities for steelhead rearing and emigration during this period of December through April. Predicted temperatures in the Feather River are expected to be within, or below, the preferred range for steelhead rearing and emigration during the period of December through April. Steelhead are not expected to migrate as smolts when the predicted water temperatures exceed 60°F from May through September. The preferred temperatures for smoltification are less than

57 °F (McEwan and Jackson 1996) and water temperatures in excess of 55 °F inhibit formation and decrease activity of gill (Na and K) ATPase activity in steelhead, with concomitant reductions in migratory behavior and seawater survival (Zaugg and Wagner 1973, Adams et. al 1975). It is currently unknown where these juveniles take up residence after migrating and the effects associated with this behavior are also unknown.

Results from the Feather River chinook salmon emigration studies indicate virtually all spring-run chinook juveniles in the Feather River exit as sub-yearlings. Emigration of chinook young-of-year begins immediately following emergence in late November, peaks in December or February, and continues through May (DWR 1999a, DWR 1999b, DWR 1999c, DWR 2000). Predicted flow conditions in the Feather River from February 2001, through January 2001, are expected to provide adequate depths and velocities for the rearing and emigration of spring-run chinook salmon juveniles. Predicted water temperatures in the Feather River from November 2001, through April 2002, are expected to be within, or below, the preferred range for rearing and emigration of spring-run chinook salmon juveniles.

Sacramento-San Joaquin Delta

During the period from December through May, the Delta provides habitat for steelhead by (1) serving as a migration corridor for upstream migrating adults returning to freshwater to spawn; (2) serving as a migration corridor for downstream migrating juveniles to the ocean; and (3) it may provide short-term rearing habitat for juveniles as they move downstream towards the ocean. For spring-run chinook salmon the Delta also serves these three purposes during the period between December and March, but most adult upstream migrants would be expected to pass through the Delta after March 31.

From February 2001, through January 2002, Reclamation and DWR propose to operate the Delta export pumps and Delta Cross Channel gates in compliance with SWRCB permits, existing biological opinions for winter-run chinook salmon and delta smelt, the 1995 Bay-Delta Water Quality Control Plan (D-1641), and all CVPIA/AFRP (b)(2) Delta actions. Recent Delta export operations under the 1995 Water Quality Control Plan and AFRP actions have shifted pumping from the spring months to the fall and winter period. Based on the 2001 CVP/SWP Provisional Operations Plan (revised January 16, 2001), the export pumps will be operated significantly below the maximum export/inflow (E/I) standard between February 2001 and January 2002 in the 90% exceedance forecast and levels slightly below the maximum E/I standard in the 50% exceedance forecast except June, July and August which are significantly lower in both..

Adult Migration

From November through May, steelhead and spring-run chinook adults will migrate through the Delta for access to upstream spawning areas in the Sacramento and San Joaquin basins. Changes in Delta hydraulics from CVP and SWP export pumping in the south Delta are expected to affect the ability of adult steelhead and spring-run chinook to successfully "home" on their natal streams. CVP and SWP export pumping alters Delta hydraulics by reducing total Delta outflows by as much as 14,000 cfs and altering net flows in several central and south Delta channels. Steelhead and spring-run chinook adults destined for the Sacramento Basin and the Mokelumne River may experience some minor disruptions during passage through the Delta by straying temporarily off-course in north and central Delta waterways. However, closure of the Delta Cross Channel gates during this period will minimize diversion of Sacramento River water into the Central Delta and improve attraction flows in the mainstem. In addition, export curtailments in February and March to comply with the 35% E/I standard will significantly improve hydraulic conditions in Delta waterways by providing a more natural (westward) flow pattern.

In the south Delta, adult steelhead bound for the Stanislaus River could have difficulty detecting attraction flows to the lower San Joaquin River. As proposed, combined CVP and SWP export rates will significantly exceed San Joaquin River flow at Vernalis. Upstream passage of adult steelhead destined for the Stanislaus River may be delayed by export operations. In the worst case, some adult steelhead may not find the lower San Joaquin River and "stray" into one of the Eastside streams, which include the Cosumnes, Mokelumne, and Calaveras rivers. The successful spawning and ultimate contribution to natural production of these "strays" is uncertain. Concerns about attraction of adult salmon to their home streams from excessive CVP and SWP exports have been expressed by Delta fisheries researchers (Hallock et al. 1970), but impacts have not been documented to date.

Fry, Juveniles, and Smolts

Steelhead juveniles are expected to enter the Delta beginning in December and continuing through June. The majority of steelhead arriving in the Delta will be smolts and are expected to pass relatively quickly through the Delta on their way to the ocean. Most steelhead smolts are 2-year old fish ranging in size from 200 to 300 mm in length. These fish are relatively large and, thus, have good swimming ability to avoid predators and overcome unnatural (reverse) flow patterns in Delta waterways.

Spring-run chinook salmon yearling smolts will be migrating through the Delta from November through March with peak migration occurring in December or January. This emigration of spring-run chinook yearlings is thought to be primarily smolts which pass relatively quickly through the Delta on their way to the ocean. Most yearling spring-run are expected to range in size from 70 to 150 mm in length. These fish are considerably larger than the sub-yearling juvenile spring-run chinook that emigrate during the spring months, but they are smaller than most steelhead smolts.

Some young-of-the-year spring-run chinook salmon will be emigrating from the upper Sacramento Basin to the lower river and Delta during December through May. The extent of the young-of-the-year population which enters the Delta during this period, depends on their natal stream and specific hydrologic conditions. For example, the bulk of the juvenile production in Butte and Big Chico creeks is thought to emigrate as young-of-the-year from their natal tributaries from December through February (DFG 2000). Increases in streamflow and/or turbidity is thought to stimulate emigration.

As presented above for adult steelhead and spring-run chinook, changes in Delta hydraulic conditions associated with CVP and SWP export pumping inhibit the function of Delta waterways as migration corridors. Rearing habitat for juveniles and smolts is also adversely affected. Central and southern Delta channels have become conduits for carrying water to the CVP and SWP export pumping facilities. Export pumping rates proposed under both the 50% and 90% forecasts, and particularly under the 90% exceedence forecast, will create unnatural flow conditions in the central and south Delta. Net flows during December and January will generally be eastward instead of westward in the lower San Joaquin River near Jersey Point (commonly referred to as reverse flows). North of the CVP and SWP Delta pumping plants, net flows in Old and Middle rivers will be southward instead of northward. As a result of these changes in hydraulic conditions, some steelhead and spring-run chinook smolts will be diverted from their primary rearing and migration corridors. Many individuals will arrive at the CVP and SWP fish salvage facilities while others are expected to be lost en route. Indirect losses are expected to result from entrainment in 2,050 unscreened water diversions, predation, food supply limitations, and poor water quality (DFG 1998). During February and March, export curtailments to comply with the 35% E/I standard will significantly improve hydraulic conditions in Delta waterways and potential adverse effects are greatly diminished.

With the Delta Cross Channel gates closed, approximately 70 to 80% of the steelhead and spring-run chinook salmon juveniles migrating downstream in the Sacramento River are expected to remain in the Sacramento River where they are less subject to the adverse effects related to CVP and SWP Delta export pumping. The remaining 20 to 30% are expected to be transported in direct proportion with the diversion of Sacramento River flow into Georgiana Slough. If the Delta Cross Channel gates are opened for water quality improvements or other purposes, a significantly greater proportion of Sacramento River flow and juvenile fish will be diverted into the Central Delta.

Several years of fisheries investigations conducted by FWS indicate that the survival of salmon smolts in Georgiana Slough and the Central Delta is significantly reduced when compared to the survival rate for fish that remained in the Sacramento River. Investigations conducted since 1993 with late-fall run chinook salmon during December and January are probably the most applicable to emigrating steelhead and spring-run chinook yearlings in the Delta. These survival studies were conducted by releasing one group of marked hatchery-produced salmon juveniles (CWT and adipose fin clip) into Georgiana Slough while a second group is released into the lower Sacramento River. FWS results have repeatedly indicated that juvenile salmon released directly into the Sacramento River while the DCC gates are closed survive, on average, eight times greater than those released into the central Delta via Georgiana Slough (DFG 1998).

The results of these studies clearly demonstrate that juvenile salmon, and probably steelhead, are adversely affected by deleterious factors encountered in the central Delta. CVP and SWP export operations are expected to contribute to these deleterious factors through altered flow patterns in central and south Delta channels. Under the 90% exceedence forecast, flow patterns are altered to a greater degree and expected to result in a higher level of impact to emigrating steelhead and spring-run yearling smolts.

Juvenile steelhead and spring-run chinook are expected to be directly entrained at the CVP's Tracy Fish Collection Facility and the SWP's Skinner Fish Protection Facility. Mortalities are expected to occur due to predation within Clifton Court Forebay (SWP only), entrainment through the primary and secondary louvers, and stress associated with handling and transportation.

The proposed AFRP (b)(2) Delta actions for December and January are expected to reduce impacts to emigrating steelhead and spring-run chinook smolts in the Delta. These (b)(2) actions are designed to increase the survival of yearling spring-run chinook salmon by reducing export levels at the CVP's Tracy Pumping Plant and potentially the SWP Banks Pumping Plant when Delta fisheries monitoring detects periods of increased vulnerability. Past fisheries monitoring efforts and Delta fish salvage records indicate juvenile spring-run chinook salmon and steelhead presence in the Delta is often episodic during December and January. Carefully timed periods of export curtailments are expected to improve Delta hydraulics and improve flow conditions during the (b)(2) action for emigrating smolts to successfully pass through the Delta to San Francisco Bay.

In addition to the AFRP (b)(2) Delta action for December and January, the CVP and SWP will implement the Environmental Water Account (EWA) through the Fall/Winter Juvenile Salmon Decision Process (Octoberl, 2001 through January 31, 2001) for the Sacramento River. Through increased fisheries monitoring and close scrutiny of fish salvage results, the CALFED Data Analysis Team (DAT) will track potential losses of yearling spring-run chinook with marked late-fall run chinook as surrogates. It is expected that through the monitoring of surrogate fish losses and the utilization of the "yellow light" and "red light" indicators at 0.5% and 1.0 %, respectively, losses of wild spring-run chinook yearlings and steelhead originating from the Sacramento River Basin will not be lost at rates greater than that of the surrogates.

Suisun Marsh Salinity Control Structure

Recent modifications to the flashboards at the Suisun Marsh Salinity Control Structure (SMSCS) were designed to improve passage of adult salmon and steelhead when the facility is operated. Under both forecasts, DWR proposes to operate the gates from September through May 31st as needed to meet water quality control standards. The gates are opened twice each day on a tidal cycle. A three year evaluation of upstream salmon passage is currently underway. Preliminary results from the first two years indicate that modified slots instead of flashboards have not improved passage for salmon. Therefore, DWR and Reclamation have decided to postpone further testing until September 2001 and to reinstall the original flashboards. The infrequent occurrence of steelhead in Suisun Marsh and the agility of adult steelhead suggests the operation of the SMSCS structure is unlikely to impede passage to upstream spawning areas. DWR and DFG study results will be available after the 2002 control season to determine the full effectiveness of the passage improvement modifications.

Rock Slough

During the period of January 1, 2001, through March 31, 2002, operation of the Rock Slough intake at the Contra Costa Canal is expected to entrain some juvenile steelhead and spring-run chinook salmon. During the period of 1994 through 2001, entrainment monitoring conducted by the CDFG estimated from 52 to 96 steelhead juveniles were lost per year. Additional loss may have occurred through predation near the dead-end slough at the intake to the canal. CDFG estimated total chinook entrainment losses per year ranged from 262-642 between 1994 and 1996 (DWR and Reclamation 1999). No salmon or steelhead were observed entrained during 1999 (CDFG annual report to NMFS). Specific loss estimates for spring-run chinook are not available, but probably represent less than 10% of total chinook losses considering the abundance of fall-run chinook fry and juveniles in the Delta during the spring months. Additional losses of steelhead and spring-run chinook to predation are also likely to occur in the canal and in the vicinity of the Rock Slough intake.

SWP Delta Pumping Plant Fish Protection Agreement (4-Pumps Agreement)

Pursuant to the SWP's 4-Pumps Agreement, four projects which benefit spring-run chinook salmon and Central Valley steelhead have been implemented or partially funded by DWR[1]. Although the 4-Pumps Agreement was intended to address and offset only direct losses of chinook salmon and other species caused by the SWP Delta Pumping Plant, certain projects implemented by or partially funded through the 4-Pumps Agreement create benefits that mitigate not only direct, but also indirect, adverse effects to spring-run chinook salmon and Central Valley steelhead that are caused by SWP operations from March 2001, through March 31, 2002. These projects are: (1) increased overtime wages for DFG wardens, (2) funds to cover over-budget costs of the Durham Mutual and Parrot Phelan Screen and Ladders project on Butte Creek, (3) Mill and Deer Creek Water Exchange Program, and (4) San Joaquin tributary spawning habitat enhancement projects.

The 4-Pumps Agreement funds two enhanced enforcement programs throughout the range of Central Valley spring-run chinook and Central Valley steelhead. Through the provision of overtime wages for DFG wardens, the Spring-run Salmon Increased Protection Project allows for increased focus on poaching of adult chinook salmon from Sacramento River tributaries. Through the Delta-Bay Enhanced Enforcement Program, a team of ten wardens focus their enforcement efforts on salmon, steelhead, and other species of concern. These two enhanced

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[1]Based on supplemental information regarding DWR's program to mitigate the impacts of SWP operations in the Delta, including estimates of direct and indirect losses of spring-run chinook salmon smolts in the Delta from 1996 through 1998 and predicted annual spring-run chinook benefits in smolt equivalents, DWR asserts that these projects provide quantifiable benefits to spring-run chinook salmon and have more than replaced the spring-run losses resulting from the SWP's Delta operations. Although DFG disagrees with specific assumptions and calculations used by DWR in its analysis, DFG concurs based on its own analysis that for the period covered by this biological opinion, these projects that are currently implemented provide benefits that likely mitigate both direct and indirect effects to spring-run chinook salmon by SWP operations.

enforcement programs, in combination with additional concern and attention from local landowners and watershed groups on the Sacramento River tributaries which support spring-run chinook salmon summer holding habitat, has likely reduced the amount of poaching in these areas.

The provisions of funds to cover over-budget costs for the Durham Mutual/Parrot Phelan Screen and Ladders project expedited completion of the construction phase of this project which was completed during 1996. The project continues to benefit salmon and steelhead by facilitating upstream passage of adult spawners and downstream passage of juveniles.

The Mill and Deer Creek Water Exchange projects are designed to provide new wells that enable irrigators to bank groundwater in place of streamflow, thus leaving water in the stream during critical migration periods. On Mill Creek several agreements between Los Molinos Mutual Water Company (LMMWC), Orange Cove Irrigation District (OCID), DFG, and DWR allows DWR to pump groundwater from two wells into the LMMWC canals to payback LMMWC water rights for surface water released downstream for fish. Although the Mill Creek Water Exchange project was initiated in 1990 and the agreement provides for a well capacity of 25 cfs, only 12 cfs has been developed to date (Orange Cove Irrigation District 1999). In addition, it has been determined that a base flow of greater than 25 cfs is needed during the April through June period for upstream passage of adult spring-run chinook in Mill Creek (Reclamation and Orange Cove Irrigation District 1999). In some years, water diversions from the creek are curtailed by amounts sufficient to provide for passage of upstream migrating adult spring-run chinook salmon and downstream migrating juvenile steelhead and spring-run chinook. However, the current arrangement does not ensure adequate flow conditions will be maintained in all years. On Deer Creek a pilot project using two of the ten proposed pumps is planned, but is not operational at this time (Reclamation and DWR 2000).

Designated Critical Habitat

Reclamation and DWR's proposed operation of the CVP and SWP is likely to result in beneficial and adverse effects to designated critical habitat for Central Valley spring-run chinook and Central Valley steelhead during the period between Janaury 1, 2001, and March 31, 2002. Critical habitat consists of the water, substrate, and adjacent riparian zone of accessible estuarine and riverine reaches.

Anticipated effects to critical habitat in upstream areas consist primarily of changes in the magnitude and duration of peak flows below CVP and SWP reservoirs. High flow events during flood control operations may inundate stream-side gravel bars and benches. Flooding of these areas may result in stranding of juvenile fish, but can also provide juvenile salmonids access to emergent vegetation and productive near-shore habitat for foraging. Low flow events during winter months may adversely affect adult spawners by dewatering redds and subjecting spawning fish to increased fishing pressure. Stabilization of flows and tapering of peak flood events may improve conditions for spawning and incubation through reduction of scouring flow events.

In the Delta, CVP and SWP export pumping alters Delta hydraulics by reducing total Delta outflows by as much as 14,000 cfs and altering net flows in several central and south Delta channels. These changes in Delta flow patterns can adversely affect the ability of adult steelhead and spring-run chinook to successfully "home" on their natal Central Valley streams. For juvenile fish, changes in Delta flow patterns result in some steelhead and spring-run chinook smolts diverted from their primary rearing and migration corridors towards the CVP and SWP export pumps in the south Delta. The magnitude of impact to Delta flow and habitat conditions is dependent on a variety of factors including: 1) the level of exports in relation to the amount of incoming flows from the Sacramento River and the San Joaquin River, 2) amount of agricultural returns into the system, and 3) tidal cycles. The AFRP (b)(2) and EWA Delta Fish Actions in coordination with the Fall/Winter Salmon Decision Process are expected to help minimize adverse affects on Delta net flow conditions through carefully timed periods of export curtailments when significant numbers of spring-run size yearlings are emigrating through the Delta to San Francisco Bay. It is anticipated that these export curtailments will benefit Central Valley steelhead juvenile smolts as well.

The impacts described above are limited to the period of operation covered under this biological opinion (January 1, 2001 through March 31, 2002) and are not expected to result in permanent impacts to or loss of designated critical habitat for these species. Other impacts are expected to occur that may result in long-term impacts to critical habitat. These additional impacts are primarily upstream and include the increased deposition of fine sediments in spawning gravels, decreased recruitment of spawning gravels, reduced transport of large woody debris, and encroachment of riparian and non-endemic vegetation into spawning and rearing areas resulting in reduced available habitat (NMFS 1996).

Synthesis of Effects

Based on the effects analysis, the alteration of the natural hydrological cycle due to CVP/SWP reservoir operations has the potential to adversely affect incubating and juvenile lifestages of steelhead and spring-run chinook salmon in the Sacramento River downstream of Shasta Dam, Clear Creek downstream of Whiskeytown Dam, and the Feather River downstream of Oroville Dam and may adversely affect incubating and juvenile lifestages of steelhead in the American River downstream of Folsom Dam, and the Stanislaus River downstream of New Melones Dam. The unnatural flow patterns created by the operation of the Delta Cross Channel and by the CVP/SWP export facilities have the potential to adversely affect steelhead and spring-run chinook salmon adult upstream migrants and juvenile downstream migrants within the Delta. In addition, direct entrainment of juvenile and adult steelhead and juvenile spring-run chinook may occur in the Delta at the CVP/SWP export facilities, as well as at the Rock Slough pumping plant. As mentioned previously, the potential amount and extent of adverse effects due to reservoir and export facility operations are difficult to predict because they are dependent on a variety of factors.

Reservoir operations. The potential for reservoir operations to result in adverse effects such as redd scouring, redd dewatering, or juvenile stranding is dependent on precipitation patterns during the winter and spring months. Heavy rainfall is likely to trigger flood control operations at Central Valley reservoirs and result in short-term high flow events in the upper Sacramento River, Clear Creek, Feather River, American River and Stanislaus River. Adverse effects due to flood control operations will be difficult to detect because any dead or injured specimens will be within the gravel substrate of the streambed. In addition, the amount and extent of adverse effects to steelhead and/or spring-run is difficult to predict and is dependent on a number of factors including: 1) the number of spawning adults that contribute to juvenile production in each basin which fluctuates between years, 2) the location of spawning habitat used in each particular reach, 3) the timing and duration of the spawning period (i.e., timing occurs early in the potential spawning timeframe versus late in the spawning season; heavy spawning activity occurs over a few weeks versus low spawning activity protracted over several months), 4) duration of the incubation period after spawning which is dependent on a variety of factors including water temperatures, 5) the occurrence of flood operations or low flow releases in relation to the occurrence of the various lifestages (i.e., occurs when few individuals are present or when most of the year's broodstock are present), and 6) the magnitude and duration of the flood or low flow operation in relation to when fish spawned.

Delta operations. Adverse effects to spring-run chinook and steelhead resulting from altered flow patterns created by the operation of the Delta Cross Channel and the CVP/SWP export facilities are difficult to detect and quantify. However, mark-recapture studies of juvenile salmon suggest that the survival of spring-run chinook yearlings and steelhead smolts is reduced when fish are diverted from the mainstem Sacramento River into the Central Delta. Reduced survival is likely a result of degraded habitat conditions in central and southern Delta waterways, increased residence time, predation, length of migration route, reverse flows, altered salinity gradient, adverse water temperatures, contaminants, and food supply limitations (DFG 1998).

Adverse effects associated with entrainment at the CVP/SWP export facilities are more easily quantified. Direct losses of spring-run chinook yearlings can be quantified at the Tracy and Skinner fish facilities based on observations of salvaged fish. With adherence to the CALFED Operations Group, Fall/Winter Juvenile Salmon Decision Process, it is anticipated that the incidental take of juvenile spring-run chinook will not exceed one percent of the population. Coded-wire-tagged late fall-run chinook from the Coleman National Fish Hatchery will serve as a surrogate for losses of Central Valley spring-run chinook yearlings because juvenile spring-run chinook salmon are not readily distinguishable from other Central Valley chinook races in the Delta and there is no juvenile production estimate available for Central Valley spring-run chinook. These late fall-run chinook serve as an appropriate surrogate for spring-run chinook salmon losses, because they begin their emigration arid smoltification passage through the Delta at approximately the same time and size as wild spring-run chinook. Direct losses of coded-wire-tagged juvenile late fall-run chinook are expected to occur at the same rate as wild spring-run chinook salmon. Therefore, conditions which result in the loss of 1 percent of the late fall-run chinook (surrogates) are likely to have resulted in the loss of 1 percent of the spring-run chinook salmon population.

Entrainment of sub-yearling spring-run chinook salmon is also expected in the Delta between January and June. Due to their overlap in size with fall-run chinook salmon, young-of-the-year spring-run chinook can not be identified according to a size criteria. Therefore, direct losses of young-of-the-year spring-run chinook can not be monitored through observations of salvaged fish nor can direct losses be quantified. However, the number of sub-yearling spring-run chinook is likely to be low prior to March 31, 2001, because the majority of sub-yearling spring-run chinook emigration through the Delta occurs in April, May, and June.

Although entrainment of juvenile and adult steelhead will be monitored through the fish salvage operations at the Tracy and Skinner fish facilities, direct loss estimates for steelhead are not available because the estimators for losses to predation in Clifton Court Forebay, predation at Tracy fish facility, and entrainment through the primary and secondary Tracy and Skinner louver systems were developed from chinook salmon research. Existing information regarding steelhead predation losses and louver screening efficiency is insufficient to generate similar loss estimators for steelhead. However, the level of impact to steelhead smolts can be monitored from salvage estimates in prior years. Based on observations from 1993 to 2000, combined (SWP +CVP) unmarked juvenile steelhead ranged from 395 to 4,938 fish during the December through June emigration period. The average number of steelhead salvaged over the last eight years is 4,200 and the mean is 2,579 for the same period (DFG 2001, unpublished).

Additional adverse effects to juvenile steelhead and spring-run chinook may occur as a result of the operation of the Rock Slough intake of the Contra Costa Canal. Based on historical entrainment numbers at the Rock Slough Intake, anywhere between 30 to 100 juvenile steelhead and 20 to 70 juvenile spring-run chinook may be entrained in the Contra Costa Canal. These numbers represent an extremely low percentage of the overall steelhead and spring-run chinook populations.

Impacts on ESU survival and potential for recovery.

Central Valley Steelhead. According to McEwan and Jackson (1996), the annual run size for the Central Valley steelhead ESU in 1991-92 was probably less than 10,000 fish based on RBDD counts, hatchery returns and past spawning surveys. At present, wild steelhead stocks appear to be mostly confined to upper Sacramento River tributaries such as Antelope, Deer, and Mill creeks and the Yuba River (McEwan and Jackson 1996). Naturally spawning populations are also known to occur in Butte Creek, and the upper Sacramento, Feather, American, Mokelumne, Calaveras and Stanislaus rivers (McEwan 2001). However, the presence of naturally spawning populations appears to correlate well with the presence of fisheries monitoring programs, and recent implementation of new monitoring efforts has found steelhead in streams previously thought not to contain a population, such as Auburn Ravine, Dry Creek, and the Stanislaus River (IEP Steelhead Project Work Team 1999). It is possible that other naturally spawning populations exist in Central Valley streams, but are undetected due to lack of monitoring or research programs.

For steelhead within the Central Valley, there is limited data available for population estimates within any individual tributaries including those with CVP/SWP facilities, however, natural spawning estimates for the upper Sacramento River and American River were calculated in the early 1990's. In the upper Sacramento River, estimates for the period from 1967 to 1991 averaged 3,465 adults, based on RBDD counts that were corrected for harvest. This estimate includes adults that would spawn in areas of the upper mainstem Sacramento River as well as suitable tributaries above RBDD including Clear Creek. In the American River, run sizes of 305; 1,462; and 255 were estimated to have occurred for the 90/91 through 92/93 seasons, based on escapement counts at the hatchery that were corrected for harvest (McEwan and Jackson 1996). In the Stanislaus River, a small, remnant run is recognized to exist based on occasional observations of adults and downstream juvenile migrants by anglers and fishery biologists, respectively. Recent in-river steelhead production for the upper Sacramento River has been estimated by CDFG based on rotary screw trap counts at Knights Landing at 8,634 and 7,258 for the 96/97 and 97/98 season (Snider and Titus 2000). Besides naturally spawning populations occurring in streams with CVP/SWP facilities, hatchery production occurs on the Feather and American Rivers and each of the hatcheries produce 400,000+ steelhead yearlings annually to mitigate for Oroville and Folsom dams.

Although accurate population estimates for steelhead within each basin are not available and the exact number of individual steelhead within the action area that will experience adverse effects due to the implementation of CVP/SWP operations is difficult to quantify, NMFS anticipates that the amount of steelhead affected will be small relative to the Central Valley population as a whole for several reasons. First, steelhead spawning and rearing in CVP/SWP tributaries comprise only five streams of 15 to 20 steelhead spawning streams within the overall ESU. However, of the five streams included in this consultation, three are considered major sources for the steelhead population in the Central Valley (McEwan 2001). These three streams (Sacramento, Feather, and American Rivers) may contribute to smaller populations in intermittent streams during wet years, while providing a refuge sink for adults in dry years. Second, the operations of each reservoir facility will not adversely affect steelhead to the same degree and will depend on precipitation patterns and the factors mentioned in the synthesis of effects section. Third, steelhead typically outmigrate through the Delta during periods when protective measures for spring-run and winter-run chinook salmon, as well as for Delta smelt (a USFWS listed species), are implemented by the CVP/SWP Delta facilities and will likely receive similar protection.

Spring-run Chinook Salmon. Natural spawning populations of Central Valley spring-run chinook salmon are currently restricted to accessible reaches in the upper Sacramento River, Antelope Creek, Battle Creek, Beegum Creek, Big Chico Creek, Butte Creek, Clear Creek, Deer Creek, Feather River, Mill Creek, and Yuba River (DFG 1998, 2000; FWS, unpublished data). With the exception of Butte Creek and the Feather River, these populations are relatively small ranging from a few fish to several hundred. Butte Creek returns in 1998 and 1999 numbered approximately 20,259 and 3,679, respectively (DFG 2000). On the Feather River, significant numbers of spring-run chinook, as identified by run timing, return to the Feather River Hatchery. However, coded-wire-tag information from these hatchery returns indicates substantial introgression has occurred between fall-run and spring-run chinook populations in the Feather River due to hatchery practices.

In the mainstem Sacramento River and Feather River, the extent of spring-run chinook spawning is unknown but is anticipated to be very low based on spawning surveys. In Clear Creek, 35+ adult chinook were identified by FWS and DFG during the summer of 1999 between Whiskeytown Dam and the confluence with the Sacramento River; all but one were observed below McCormick-Saeltzer Dam. In 2000 only 17 adult chinook were observed, all above the McCormick-Saeltzer Dam, and of these half were lost before spawning. Phenotypic indicators suggest most, if not all, of the adult chinook salmon observed in Clear Creek during the 1999 surveys were spring-run chinook salmon. Reclamation's temperature control efforts in September 1999, avoided significant losses of incubating spring-run chinook. However, the resulting temperatures of 57 °F to 60 °F during September may have reduced the survival of some eggs and pre-emergent spring-run chinook in Clear Creek. Based on observations of emergent fry in November, these temperatures also accelerated the incubation period for these fish and it is anticipated that many of the spring-run chinook emerged from the gravels prior to December.

Although accurate population estimates for spring-run chinook salmon within each basin are not available and the exact number of individual spring-run chinook within the action area that will experience adverse effects due to the implementation of CVP/SWP operations is difficult to quantify, NMFS anticipates that the amount of spring-run chinook affected will be small relative to the Central Valley population as a whole for several reasons. First, spring-run chinook spawning and rearing in CVP/SWP tributaries comprise only 3 streams of approximately 10 to 12 spring-run chinook spawning and rearing streams within the overall ESU. Second, the operations of each reservoir facility will not adversely affect spring-run chinook to the same degree and will depend on precipitation patterns and the factors mentioned in the synthesis of effects section above. And last, the protective measures for spring-run chinook that will be implemented according to the AFRP (b)(2) Delta actions and the Sacramento River Fall/Winter Juvenile Salmon Decision Process are expected to minimize adverse affects in the Delta.

Overall Impacts

Although the exact number of individual steelhead and spring-run chinook salmon within the action area that will experience adverse effects due to the implementation of these operations is difficult to quantify, NMFS anticipates that the amount of steelhead and spring-run chinook salmon affected will be small relative to the Central Valley population as a whole. Populations of Central Valley spring-run chinook and Central Valley steelhead within Deer Creek, Mill Creek, and several other Sacramento River tributaries will essentially be unaffected by upstream CVP and SWP reservoir operations. Below CVP and SWP reservoirs, flow conditions are predicted to provide adequate depths and velocities for spawning, rearing, and migration in the 50% exceedance forecasts. However, in a dry year forecast (90% exceedance) low flows may adversely affect Central Valley steelhead and water temperatures are predicted to be above the preferred range for egg incubation, juvenile rearing, and emigration in the American, Feather and Stanislaus rivers. Therefore, the level of incidental take resulting from CVP and SWP operations addressed in this Opinion is not expected to appreciably reduce the likelihood of survival and recovery of the CV steelhead and CV spring-run chinook salmon populations.

IV. CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, tribal, local, or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA.

Non-Federal actions that may affect the action area include State angling regulation changes, voluntary State or private sponsored habitat restoration activities, State hatchery practices, agricultural practices, water withdrawals/diversions, increased population growth, mining activities, and urbanization. State angling regulations are generally moving towards greater restrictions on sport fishing to protect listed fish species. Habitat restoration projects may have short-term negative effects associated with in-water construction work, but these effects are temporary, localized, and the outcome is a benefit to these listed species. State hatchery practices may have negative effects on naturally produced salmonids through genetic introgression, competition, and disease transmission resulting from hatchery introductions. Farming activities within or adjacent to the action area may have negative effects on Sacramento River water quality due to runoff laden with agricultural chemicals. Water withdrawals/diversions may result in entrainment of individuals into unscreened or improperly screened diversions, and may result in depleted river flows that are necessary for migration, spawning, rearing, flushing of sediment from spawning gravels, gravel recruitment and transport of large woody debris. Future urban development and mining operations in the action area may adversely affect water quality, riparian function, and stream productivity.

VI. CONCLUSION

After reviewing the current status of the threatened Central Valley steelhead and Central Valley spring-run chinook salmon, the environmental baseline for the action area, the effects of the proposed operations for the CVP and SWP from January 2001 through March 2002, and cumulative effects, it is NMFS' biological opinion that CVP and SWP operations from January 2001 through March 2002, as proposed, are not likely to jeopardize the continued existence of the Central Valley steelhead, the Central Valley spring-run chinook salmon, or result in the destruction or adverse modification of their designated critical habitat.

Notwithstanding NMFS' conclusion that the CVP and SWP operations from January 2001 through March 2002, are not expected to jeopardize the continued existence of Central Valley steelhead and Central Valley spring-run chinook salmon, NMFS anticipates that some actions associated with these operations may result in incidental take of the species. Therefore, an incidental take statement is provided with this Biological Opinion for these actions.

VII. INCIDENTAL TAKE STATEMENT

Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. Harm is further defined to include significant habitat modification or degradation which actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and 7(o)(2), taking that is incidental to and not intended as part of the proposed action is not considered to be prohibited taking under the ESA provided that such taking is in compliance with this Incidental Take Statement.

Section 7 (b)(4) of the ESA requires that when a proposed agency action is found to be consistent with section 7(a)(2) of the ESA, and the proposed action may incidentally take individuals of a listed species, NMFS will issue a statement that specifies the impact of any incidental taking of endangered or threatened species. It also states that reasonable and prudent measures, and terms and conditions to implement the measures, be provided that are necessary to minimize such impacts. Under the terms and conditions of section 7(o)(2) and 7(b)(4), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the ESA provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

The measures described below are non-discretionary and must be implemented by Reclamation and DWR, for the exemption in section 7(o)(2) to apply. Reclamation and DWR have a continuing duty to regulate the activity covered in this incidental take statement. If Reclamation and/or DWR (1) fail to assume and implement the terms and conditions of the incidental take statement, and/or (2) fail to require the applicant to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, Reclamation and DWR must report the progress of the action and its impact on the species to NMFS as specified in this incidental take statement (50 CFR §402.14(i)(3)).

This incidental take statement is applicable to all activities related to the operation of the Central Valley Project (CVP) and State Water Project (SWP) described in this opinion. Unless modified, this incidental take statement does not cover activities that are not described and assessed within this opinion. In addition, unless modified, this incidental take statement does not cover the facilities or activities of any CVP or SWP contractor, or the facilities or activities of parties to agreements with the U.S. that recognize a previous vested water right.

A. Amount or Extent of Take

The NMFS anticipates that threatened Central Valley steelhead and Central Valley spring-run chinook salmon will be taken as a result of this proposed action. The incidental take is expected to be in the form of death, injury, harm, capture, and collection. Death, injury, and harm to juvenile and adult steelhead and spring-run chinook salmon are anticipated from the depletion and storage of natural flows at CVP and SWP reservoirs. Reservoir operations are expected to significantly alter the natural hydrological cycle in the Sacramento River downstream of Shasta Dam, Clear Creek downstream of Whiskeytown Dam, the Feather River downstream of Oroville Dam, the American River downstream of Folsom Dam, and the Stanislaus River downstream of New Melones Dam.

Reservoir releases to downstream areas during flood control operations may result in the take of steelhead eggs and pre-emergent fry through the scouring of redds. The potential amount and extent of take of steelhead eggs and pre-emergent fry is difficult to predict, because it is directly dependent on precipitation patterns during the upcoming winter and spring months. Heavy rainfall is likely to trigger flood control operations at Central Valley reservoirs and result in short-term high flow events in the upper Sacramento River, Clear Creek, Feather River, American River and/or Stanislaus River. Extremely high flow events may scour steelhead redds and result in the injury and mortality of steelhead eggs and sac-fry. Incidental take of steelhead due to flood control operations will be difficult to detect, because any dead or injured fish will be within the gravel substrate of the streambed.

Flood control operations can also lead to the incidental take of fry and juvenile steelhead and spring-run chinook through stranding and isolation. Isolation may occur in areas that are not connected to the river or creek except during periods of high flows. Heavy rainfall is likely to trigger flood control operations at Central Valley reservoirs and result in short-term high flow events in the upper Sacramento River, Clear Creek, Feather River, American River and/or Stanislaus River. During periods of high flows, juvenile steelhead and spring-run chinook may enter into areas that become isolated from the creek once flows recede. If additional high flow events do not follow within a short period of time, these isolated fish may be lost to predation, lethal water temperature conditions, or dessication. Incidental take of fry and juvenile steelhead is anticipated if precipitation patterns result in flood control operations. However, the extent of isolation will be difficult to detect and quantify due to the large geographic area that will be affected and finding a dead or injured specimen is unlikely without a systematic survey immediately following the flood event. Take of adult steelhead is unlikely to occur as a result of flood control operations and no take of adult spring-run chinook salmon is anticipated.

Delays to adult spring-run chinook salmon occur when RBDD gates are in the closed position between May 15 and July 30. Average delays of 11 days (range from 1- 40 days) have been reported by radio-tagging experiments on spring-run chinook (USFWS 1990) These delays may increase the chance that adult spawners will be unable to access some tributary streams above RBDD due to low flows and thermal barriers developing at the tributary mouth. The potential amount of take associated with this is difficult to predict, but it is assumed that spring-run chinook that can not access their natal stream of origin would either die without spawning or continue up the mainstem Sacramento River to spawn shortly before or with the fall-run chinook.

Dry conditions or moderate precipitation will create low instream flows below SWP and CVP controlled reservoirs, such conditions could result in take of steelhead eggs and pre-emergent fry through dewatering of redds and take of over-summering juvenile steelhead through high water temperatures. In the 90% exceedance forecast water temperatures would reach lethal limits for juvenile steelhead in the Feather River low flow channel from June through August and in the American River from April through October. In the 50% exceedance forecast water temperatures are in the preferred range for steelhead and spring-run chinook salmon for a portion of the streams directly below the dams: Sacramento River from Keswick Dam to Red Bluff, American River from Nimbus Dam to Watt Avenue, Feather River from Oroville Dam to the Thermalito Afterbay, Stanislaus River from Tulloch Dam to Oakdale and Clear Creek from Whiskeytown Dam to the Powerline Crossing Road (RM 5). Water temperatures above the preferred ranges for these two species will limit the available habitat to the above described reaches for juvenile over summer rearing and emigration. Low flow conditions forecasted for dry conditions (90% exceedance forecast) or below normal precipitation can lead to rapid decreases in stream flows during critical spawning times, as it did on the American River in February 2001 (see Calfed Fish Action #3), which may dewater steelhead redds or adversely effect adults by exposing them to increased fishing pressure from anglers. Low flow conditions can also prevent spring-run chinook adults from reaching their spawning areas by creating thermal barriers at the stream mouth and subjecting the adults to increased poaching or predators in summer holding pools (ie: Clear Creek).

Capture and collection of juvenile steelhead in the Stanislaus River by screw traps is anticipated through fisheries studies to evaluate New Melones Reservoir operations on anadromous salmonids. Based on past sampling by screw trap at the Oakdale sampling site, approximately 20 to 30 steelhead smolts and pre-smolts may be captured and released below the trapping site. Steelhead fry have not been captured in previous years and few, if any, are expected to be captured in the winter 2001/2002 sampling season. Previous sampling experience with screw traps in the Stanislaus River indicates that all captured steelhead will be maintained in good physical condition and released unharmed back into the river. No take of adult steelhead in the Stanislaus River fisheries investigations is anticipated.

In the Delta, death, injury, and harm to juvenile and adult steelhead and spring-run chinook are anticipated due to unnatural flow patterns created by the operation of the Delta Cross Channel and CVP/SWP export pumping. This take includes that incurred by salvage activities, predation associated with physical structures, losses due to entrainment at water diversions, and straying of adult upstream migrants. Additional take of juvenile steelhead and spring-run chinook is expected at Rock Slough intake at the Contra Costa Canal. Take through the capture and collection of juvenile and adult steelhead, and juvenile spring-run chinook at the Tracy and Skinner Fish Facilities is anticipated. At the Suisun Marsh Salinity Control Structure take is anticipated from delays in upstream and downstream fish passage when the gates are tidally operated.

In the Delta, incidental take due to the operation of the Delta Cross Channel and export pumping plants is expected from both direct and indirect losses. Direct losses can be quantified at the Tracy and Skinner fish facilities based on observations of salvaged fish. Indirect losses, however, can not be easily quantified, because juvenile fish dead or injured as a result of altered flow patterns and the resulting exposure to degraded habitat conditions in the central Delta are not likely to be detected. Indirect losses ofjuvenile spring-run chinook and steelhead in the Delta are generally attributed to increased residence time, length of migration route, reverse flows, altered salinity gradient, predation, adverse water temperatures, contaminants, and food supply limitations (DFG 1998, McEwan 2001).

Although indirect losses in the Delta can not be quantified, direct losses of spring-run chinook yearlings and steelhead smolts will be monitored at the Tracy and Skinner fish facilities. Based on adherence to the CALFED Operations, Fall/Winter Salmon Decision Process, it is anticipated that the incidental take ofjuvenile spring-run chinook will not exceed one percent of the population. Coded-wire-tagged late fall-run chinook from the Coleman National Fish Hatchery will serve as a surrogate for losses of Central Valley spring-run chinook yearlings, because juvenile spring-run chinook salmon may not be distinguishable from other Central Valley chinook races in the Delta and there is no juvenile production estimate available for Central Valley spring-run chinook. These late fall-run chinook should serve as an appropriate surrogate for spring-run chinook salmon losses because NMFS expects that these fish, which begin their emigration and smoltification passage through the Delta at approximately the same time and size as wild spring-run chinook, will be taken at the same rate as wild spring-run chinook salmon. Therefore conditions which result in the loss of one percent of the late fall-run chinook are likely to have resulted in the loss of one percent of the spring-run chinook salmon population.

Take of young-of-the-year spring-run chinook salmon is expected in the Delta between December and May. Juvenile spring-run chinook arriving in the Delta as sub-yearlings will be subject to direct and indirect losses. Due to their overlap in size with fall-run chinook salmon, losses of young-of-the-year spring-run chinook can not be precisely quantified or monitored through observations of salvaged fish. Based on the fall and spring run young-of-the-year (YOY) losses at the facilities from 1994-1998 (DWR 1999) the spring run represented less the one percent of the total loss while Sacramento fall run accounted for 7.4% and the San Joaquin fall run made up the majority at 92.5%. The total combined YOY loss from 1994- 1998 ranged from 11,258 to 124,816, with an average loss of 74,087 per year.

Take ofjuvenile steelhead will be monitored through the fish salvage operations at the Tracy and Skinner fish facilities. However, direct loss estimates for steelhead are not available, because estimators for losses to predation in Clifton Court Forebay, predation at Tracy fish facility, and entrainment through the primary and secondary Tracy and Skinner louver systems were developed from chinook salmon research. Existing information regarding steelhead predation losses and louver screening efficiency is not adequate to generate similar loss estimators for steelhead. However, the level of take of steelhead can be anticipated from salvage estimates in prior years. Based on salvage data from the last eight years (1993-2000), the number of undipped juvenile steelhead salvaged from both the CVP and SWP facilities is expected to range from approximately 300 to 18,000 fish during the period between December and June. The average annual steelhead salvaged since 1993 is 4,200. In 2000 the number of nonmarked juvenile steelhead salvaged from December to March exceeded the 3,400 incidental take limit set by NMFS in the interim OCAP biological opinion (dated March 27, 2000). At Rock Slough, from 30 to 100 juvenile steelhead and 20 to 70 juvenile spring-run chinook may be taken through entrainment into the Contra Costa Canal.

Reclamation and DWR have proposed to operate CVP and SWP facilities in accordance with either plans, agreements, or specific criteria outlined in this biological opinion. Deviations from these plans, agreements, or criteria may result in adverse impacts to Central Valley spring-run chinook salmon and steelhead that have not been analyzed in this opinion. In this event, formal consultation shall be reinitiated immediately to analyze the effects to spring-run chinook salmon and steelhead and determine if the changes are likely to jeopardize these species or result in additional incidental take.

B. Effect of the Take

The effect of this action in the up river areas will consist of fish behavior modification, temporary loss of habitat value, and potential death or injury of juvenile steelhead and spring-run chinook as a result of streamflow fluctuations in the upper Sacramento River, Clear Creek, Feather River, American River, and Stanislaus River. In the Sacramento-San Joaquin Delta, the effect of this action will alter fish behavior, result in modification of habitat value, and result in the death and injury of juvenile fish as a result of altered Delta flow patterns and direct loss at the Tracy and Skinner fish collection facilities.

In the accompanying biological opinion, NMFS determined that this level of anticipated take is not likely to result in jeopardy to the listed species or destruction or adverse modification of designated critical habitat.

C, Reasonable and Prudent Measures

NMFS believes the following reasonable and prudent measures are necessary and appropriate to minimize take of Central Valley steelhead and Central Valley spring-run chinook salmon:

1. Reclamation and DWR shall minimize the adverse effects of flow fluctuations associated with upstream reservoir operations on the incubating eggs, fry, and juvenile steelhead and spring-run chinook.

2. Reclamation and DWR shall gather information regarding the effects of flow fluctuations on chinook salmon and steelhead downstream of CVP and SWP reservoirs, develop long-term ramping criteria, and meet temperature objectives that will avoid or minimize adverse effects.

3. Reclamation and DWR shall meet temperature objectives below project Dams that will avoid or minimize adverse effects to spring-run chinook salmon and steelhead.

4. Reclamation shall minimize the adverse effects of Delta Cross Channel gate operations on juvenile steelhead and spring-run chinook salmon.

5. Reclamation and DWR shall minimize the adverse effects of Delta exports on juvenile steelhead and spring-run chinook salmon.

6. Reclamation and DWR shall collect additional data at the fish salvage collection facilities for improving facility operations and incidental take monitoring with regard to steelhead and spring-run chinook.

7. Reclamation and DWR shall continue to provide benefits to spring-run chinook and steelhead to mitigate the direct and indirect adverse effects of CVP and SWP operations on spring-run chinook salmon and steelhead.

D. Terms and Conditions

Reclamation and DWR must comply or ensure compliance by their contractor(s) with the following terms and conditions, which implement the reasonable and prudent measures described above. These terms and conditions are non-discretionary.

1. Reclamation and DWR shall minimize the adverse effects of flow fluctuations associated with upstream reservoir operations on the incubating eggs, fry, and juvenile steelhead and spring-run chinook.

    a. Reclamation and DWR shall not reduce releases downstream of Keswick Dam, Whiskeytown Dam, Nimbus Dam, Oroville Dam, and/or Goodwin Dam to a monthly average flow below the levels identified in the February 15, 2001, 90% exceedence forecast without submission of a revised project description and reinitiation of consultation with NMFS.

    b. Clear Creek - Reclamation shall adopt the flow recommendations of the Fisheries Management Plan (FMP) being designed by CDFG, USFWS and NMFS specifically for Clear Creek. If Reclamation proposes to decrease flows from Whiskeytown Dam below the FMP recommended level, Reclamation must reinitiate consultation with NMFS prior to taking the action. A schedule for implementation of the FMP must be submitted to NMFS for review and approval by July 1, 2001.

    c. Feather River - During periods outside of flood control operations and to the extent controllable during flood control operations, DWR shall ramp down releases to the low flow channel as presented in the table below:

Feather River Low-Flow Channel Releases (cfs)	Rate of Decrease (cfs)
5,000 to 3,501	1,000 per 24 hours
3,500 to 2,501	500 per 24 hours
2,500 to 600	200 per 24 hours

d. American River - During periods outside of flood control operations and to the extent controllable during flood control operations, Reclamation shall ramp down releases in the American River below Nimbus Dam as presented in the table below. From December 1 through March 30 Reclamation must insure fisheries monitoring is conducted during ramp down of streamflows below 1500 cfs to prevent dewatering of steelhead redds or adverse effects to incubating eggs.

During any 24 hour period do not decrease Nimbus flows (measured in cfs) more than the ranges shown in column 1	Do not make individual Nimbus release decreases (measured in cfs) greater than values in column 2
Column 1 - Daily Rate of Change	Column 2 - Individual Rate of Change
20,000 to 16,000	1,000 - 1,500
16,000 to 13,000	1,000
13,000 to 11,000	500-800
11,000 to 9,500	500
9,500 to 8,000	500
8,000 to 7,000	300-350
7,000 to 6,000	300-350
6,000 to 5,500	250
5,500 to 5,000	250
5,000 to 1500	250
1500 to 250	100 per 24 hours

e. Stanislaus River - During periods outside of flood control operations and to the extent controllable during flood control operations, Reclamation shall ramp releases in the Stanislaus River below Goodwin Dam as presented in the table below:

Existing Release Level (cfs)	Rate of Increase (cfs)	Rate of Decrease (cfs)
at or above 4,000	1,000 per 2 hours	500 per 4 hours
2,000 to 3,999	500 per 2 hours	500 per 4 hours
500 to 1,999	250 per 2 hours	200 per 4 hours
300 to 499	100 per 2 hours	100 per 4 hours
150 to 299	75 per 2 hours	50 per 4 hours

2. Reclamation and DWR shall gather information regarding the effects of flow fluctuations on chinook salmon and steelhead downstream of CVP and SWP reservoirs, develop long-term ramping criteria, and meet temperature objectives that will avoid or minimize adverse effects.

   a. Reclamation shall design and implement a monitoring program for Central Valley steelhead that will include adult and juvenile direct counts, redd surveys, and escapement estimates during March 2001 through March 2002. The program shall include identification and evaluation of steelhead rearing and spawning habitat along with areas of potential of isolation. This information shall serve as a basis for establishing long-term ramping rate criteria and a temperature compliance point. The monitoring proposal and schedule for implementation must be submitted to NMFS for review and approval by July 1, 2001. If appropriate, authorization for any incidental take associated with the implementation of these monitoring programs will be provided to Reclamation, or its agent, after NMFS review and approval of the study plans.

   b. All monitoring programs that involve the intentional taking of spring-run chinook salmon or steelhead must be conducted by a person or entity that has been authorized by NMFS.

   c. Reclamation shall provide a written report regarding results of the 2000/2001 Stanislaus River fisheries monitoring studies to NMFS (Southwest Region, Protected Resources Division, Sacramento Area Office, 650 Capitol Mall, Suite 8-300, Sacramento, California 95814-4706) by September 1, 2001. The report shall include: (1) the number of steelhead captured; (2) fork length; (3) condition (e.g., alive, injured, dead, and life stage characterization); (4) the number of steelhead released back into the river; and (5) other information collected (e.g., velocity, temperature, and turbidity measurements, etc). Life stage characterization guidelines are available in the Steelhead Life-Stage Assessment Protocol developed by the Interagency Ecological Program Steelhead Project Work Team (December 1998).

d. At least one trained and qualified fisheries technician (minimum of 2 years experience with sampling and handling of juvenile anadromous salmonids) shall be onsite during each day of sampling throughout the duration of the fisheries monitoring program to insure full adherence to the sampling and handling protocols identified in the Stanislaus River Sampling Plan submitted by Reclamation on May 14, 1999. Incidental take of juvenile steelhead in the Stanislaus River by rotary screw traps may not exceed 20 steelhead smolts in one sampling season.

e. DWR shall provide a written report containing the results of rotary screw traps, fyke traps, snorkel surveys, creel census and tissue sampling for 1999/2000 and 2000/2001 monitoring studies to NMFS (Southwest Region, Protected Resources Division, Sacramento Area Office, 650 Capitol Mall, Suite 8-300, Sacramento, California 95814-4706). In addition, DWR will continue with the stranding and isolation study as proposed in its August 7, 2000 report to NMFS. Incidental take of juvenile steelhead or spring-run chinook salmon associated with rotary screw trap monitoring may not exceed a 2% mortality rate. Incidental take associated with the stranding and isolation study shall be as follows:

steelhead juveniles : 600
steelhead adults: 25
spring-run size salmon(YOY): 3,000
spring-run size salmon(juveniles): 10

f. At least one trained and qualified fisheries technician (minimum of 2 years experience with sampling and handling of juvenile anadromous salmonids) shall be onsite during each day of sampling throughout the duration of the fisheries monitoring program to insure full adherence to the sampling and handling protocols identified in the Stranding and Redd Dewatering Study Plan submitted by DWR on August 7, 2000.

3. Reclamation and DWR shall meet temperature objectives below project Dams that will avoid or minimize adverse effects to spring-run chinook salmon and steelhead.

a. Clear Creek - In the absence of a FMP, Reclamation shall control releases to meet a daily water temperature of 65°F from Whiskeytown Dam to the Powerline Crossing Road (RM5) from June through September to protect over-summering steelhead from thermal stress and from warm water predators.

b. American River - Reclamation shall to the extent possible control water temperatures by flow releases to the lower river between Nimbus Dam and Watt Avenue Bridge (RM 9.4) from June 1 through November 30 to a daily average temperature of less than or equal to 65°F to protect rearing juvenile steelhead from thermal stress and from warm water predator species.

c. Stanislaus River - Reclamation shall to the extent possible control water temperatures by flow releases to the lower river between Goodwin Dam (RM 58.5) and Oakdale (RM 41.2) from June 1 through September 30 to a daily average temperature of less than or equal to 65°F to protect over-summering steelhead from thermal stress and from warm water predator species.

d. Feather River - DWR shall to the extent possible control water temperatures by flow releases to the Low Flow Channel (Fish Barrier Dam to the Thermalito Afterbay Outlet) from June 1 through September 30 to a daily average temperature of less than or equal to 65°F to protect over-summering steelhead from thermal stress and from warm water predator species.

4. Reclamation shall minimize the adverse effects of Delta Cross Channel gate operations on juvenile steelhead and spring-run chinook salmon.

a. During the period from March 2001 through March 31, 2002, Reclamation shall operate the gates of the Delta Cross Channel (DCC) consistent with the CALFED Operations Group, Fall/Winter Juvenile Salmon Decision Process (October 1-January 31, 2001). Reclamation and NMFS, in coordination with the CALFED Data Assessment Team (DAT) will monitor water quality conditions within the Delta. Gate openings for water quality improvements shall be coordinated with NMFS, Sacramento Area Office and openings shall be minimized if fisheries monitoring results indicate juvenile chinook and steelhead are emigrating in the vicinity of the DCC.

b. To address the potential competing objectives of water quality improvement and fisheries protection, Reclamation and DWR shall develop specific water quality criteria, operational rules, and decision making process for operation of the DCC gates during the period between October 1 and January 31, 2001. This effort shall include investigation of whether hydrodynamic models can be used to predict potential water quality problems and alternative operations scenarios for the DCC gates and the Delta export pumps. Updated water quality criteria, operational rules, and the decision-making process shall be provided to NMFS for review and concurrence as revisions occur.

5. Reclamation and DWR shall minimize the adverse effects of Delta exports on juvenile steelhead and spring-run chinook salmon.

a. Based on observations of juvenile steelhead, juvenile spring-run size chinook salmon (70 mm to 150 mm), or late-fall chinook salmon surrogates (CWT fish from Coleman National Fish Hatchery) in: (1) lower Sacramento River fisheries monitoring stations (Knight's Landing, Sacramento Trawl, beach seine program); (2) Delta fisheries monitoring stations (beach seine program, Chipps Island); or (3) Tracy or Skinner fish salvage facilities; Reclamation and DWR shall reduce CVP and SWP pumping levels to improve the survival of steelhead and spring-run chinook smolts in the Delta for periods extending from 5 to 10 days. These export reductions to a combined CVP/SWP pumping rate of 4,000 to 10,000 cfs, depending on Delta inflow conditions, will be implemented based on the protocol and water quality criteria established in the Fall/Winter Juvenile Salmon Decision Process (October 1 - January 31) and initiated by NMFS. The decision to implement these export curtailments, it's duration, and specific export level will be made by the Data Analysis Team (DAT) in coordination with Reclamation and DWR. NMFS will provide Reclamation and DWR, at minimum, 24 hours notice prior to the initiation of the target CVP/SWP export rates. NMFS will make every effort possible to combine these export curtailments with the currently proposed (b)(2) actions by FWS, but curtailments pursuant to this term and condition are not constrained by the Department of Interior's (b)(2) water budget.

b. Incidental take of yearling spring-run chinook salmon at the CVP and SWP Delta export facilities will be based on observations of CWT late-fall chinook salmon uniquely marked at Coleman National Fish Hatchery and released in the upper Sacramento Basin. Loss at the CVP and SWP Delta export facilities may not exceed 1% of any individual release group of CWT late fall chinook surrogates released in the upper Sacramento Basin (0.5% yellow light, 1% red light) from December 1, 2001, through March 31, 2002. Take will be calculated with the standard loss estimation procedures applicable at the respective fish collection facilities. At the 1% cumulative loss level (red light), Reclamation and DWR must take actions to avoid further loss and reinitiate consultation, if not already reinitiated at yellow light.

c. Incidental take of YOY spring-run chinook salmon from December to May shall be limited to the 5 year average (1994-1998) of estimated loss for total combined YOY at the Delta Fish Facilites. YOY loss may not exceed 74,087 for all YOY chinook salmon at the Delta Fish Facilities.

d. Incidental take of juvenile steelhead at the CVP and SWP Delta export facilities will be based of observations of unmarked steelhead at the Tracy and Skinner fish collection facilities. Cumulative salvage of unmarked juvenile steelhead (less than 350 mm) at the CVP and SWP combined may not exceed 4,500 fish (2,250 fish yellow light, 4,500 fish red light) from January 1, 2001, through March 31, 2002, based on the salvage estimation procedures described in the 4-Pumps Agreement at the respective collection facilities. If cumulative salvage of unmarked juvenile steelhead reaches 4,500 fish, Reclamation and DWR must take actions to avoid further collection and salvage of juvenile steelhead and reinitiate consultation, if not already reinitiated at yellow light.

6. Reclamation and DWR shall collect additional data at the fish salvage collection facilities for improving facility operations and incidental take monitoring with regard to steelhead and spring-run chinook.

   a. DNA tissue samples from juvenile spring-run chinook salmon and steelhead at the Tracy and Skinner fish collection facilities shall be collected by DWR or CDFG for genetic analysis pursuant to the sampling protocols established by the IEP Salmon Genetics Project Work Team. Tissues shall be stored at the DFG tissue bank at Rancho Cordova for subsequent analysis by Bodega Marine Lab or similar lab approved by NMFS.

   b. From October 1 through June 30, Reclamation and DWR must calculate estimates of steelhead loss (incidental take) on a real-time basis similar to how winter-run chinook salmon loss is calculated for each facility.

   c. Reclamation and DWR must use personnel for monitoring at the fish salvage facilities that are experienced in the sampling and handling of juvenile anadromous salmonids.

7. Reclamation and DWR shall continue to provide benefits to spring-run chinook and steelhead to mitigate the direct and indirect adverse effects of CVP and SWP operations on spring-run chinook salmon and steelhead.

   a. DWR shall continue to implement and/or fund projects pursuant to the 4-Pumps Agreement, including the four projects listed herein.

   b. Reclamation and DWR shall work with NMFS, FWS and DFG to implement and/or fund any other projects that are deemed necessary and appropriate to provide for the protection and/or recovery of Central Valley spring-run chinook salmon or steelhead.

   c. Reclamation and DWR shall work with NMFS, FWS and DFG to implement and/or fund any monitoring projects that Reclamation, DWR, DFG, FWS or NMFS agree are necessary and appropriate to monitor incidental take levels or provide for the protection and/or recovery of Central Valley spring-run chinook salmon or steelhead.

VII. CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. These "conservation recommendations" include discretionary measures that Reclamation and DWR can take to minimize or avoid adverse effects of a proposed action on a listed species or critical habitat or regarding the development of information. In addition to the terms and conditions of the Incidental Take Statement, the NMFS provides the following conservation recommendations that would reduce or avoid adverse impacts on the listed species:

1. Reclamation and DWR should support expanded anadromous salmonid monitoring programs throughout the Central Valley to improve our understanding of the life history of these listed species and improve the ability to provide fisheries protection through real-time management of CVP/SWP facilities.

2. Reclamation and DWR should support and promote aquatic and riparian habitat restoration downstream of CVP/SWP reservoirs with special emphasis upon the protection and restoration of shaded riverine aquatic cover and increase the existing stream meander zone.

VIII. REINITIATION OF CONSULTATION

This concludes formal consultation on the actions outlined in the biological opinion for the proposed operation of the CVP and SWP from January 1, 2001, through March 31, 2002. As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary Federal involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered in this opinion; (3) the action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, formal consultation shall be reinitiated immediately.

IX. LITERATURE CITED

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